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An Assessment of Aerial Application Technology

USDA-Forest Service
Forest Pest Management
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AN ASSESSMENT OF AERIAL APPLICATION TECHNOLOGY[1]

1. PROBLEM.

a. Is the USDA Forest Service effectively using existing technology for aerial application of pesticides?

b. What can be done to increase the use of this technology?

c. What are the most significant knowledge or technology gaps affecting safe and efficient aerial application of pesticides?

2. ASSUMPTION. Funding and manpower to support aerial application technology will not exceed levels of previous fiscal years.

3. FACTS BEARING ON THE PROBLEM.

a. The FS has a commitment to practice Integrated Pest Management (IPM). IPM includes pesticide use as a tool of IPM.

b. Aerial application continues to be the most efficient method of applying pesticides to range and forests and lands.

c. The FS must maintain a capability to conduct safe and effective aerial spray control projects.

4. DISCUSSION.

a. Introduction and Background.

The approach taken to conduct this study was: (1) To review progress in aerial application technology since 1978 (publication of the FS aerial application technology problem analysis); (2) to canvass the field on problems and needs; and (3) to assess, as objectively as possible, my field observations of FS activities involving aerial application technology.

Pesticides include both herbicides and insecticides. Besides differences in the use and purpose of these pesticides, herbicides generally are applied at higher volumes and in larger droplet size than insecticides. Within the realm of FS activities, herbicides are used more widely than insecticides. Administratively there are also differences. The staff responsibility at the Regions and Areas for pesticide use rests with Forest Pest Management (FPM) of State and Private Forestry. Aerial spray

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1 This assessment is in response to request by James L. Stewart, Director, Forest Pest Management, USDA-Forest Service, for an assessment of aerial application technology.

control projects involving insecticides on national forest lands are usually supported by FPM personnel while herbicide projects are usually handled at the district level with staff coordination shared by FPM, Range, and Timber staffs. Nevertheless there are many analogies in use between these two types of pesticides. Problems in application, drift management, project administration, contracting, personnel qualifications, etc., are identified with both herbicides and insecticides.

Appropriate background information is provided in Annex A.

b. Progress in Aerial Application Technology

Considerable progress has been made by the FS in advancing its capability to conduct aerial application projects to control defoliators since 1978. This is not to imply that little progress was made prior to 1978. The fact remains, however, that the FS has made significant progress in aerial application technology since the initiation of a problem analysis[1] to review state-of-the-art of aerial spraying. The Analysis itself helped to assimilate, rank, assess, and relate technological needs. No formal aerial application program, however, was initiated as a result of the Analysis. Organizational elements within the FS and cognizant staff specialists continued existing projects and initiated others to address technology needs identified in the Analysis. Forest Service progress in aerial application since 1978 is reviewed in Annex B. It is entirely conceivable that the FS advanced its aerial application capability using existing program dollars and manpower, as fast or faster, than would have been possible by establishing a new program.

c. Field Needs Relative to Aerial Application

To ascertain field needs and to solicit ideas on aerial application, an informal inquiry was sent to Regional and Area pesticide use coordinators. Responses are summarized in Annex C. As expected the responses reflected Regional and Area pesticide use policy. Each response was presented in a positive manner and indicated a wide range of capability in managing aerial application of pesticides, particularly herbicides. Needs and problems are summarized below as follows:

(1) Contracting for aerial application. There was an expressed need to standarize aerial application contracts. Several expressed a preference to full service contracts due to savings in time and manpower. Full service contracts are effective, but like other contracts, specifications must be well developed and the contractor monitored closely. The COR should be experienced and given authority to insure contractor compliance. It is important to contract the services of an experienced and competent contractor. The contract should provide the equipment on site 24 hours prior to spraying. There are problems in proper handling and disposal of pesticides and containers by contractors. A full service contract should include provisions for pesticide handling. Full service contracts, as with other contracts, have the potential of causing embarrassment to the FS if contract specifications are not followed and if there are pesticide label violations.

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1 Ekblad, Robert, Jack Armstrong, John Barry, James Bergen, Imants Millers, and Patrick Shea. 1979. A Problem Analysis--Forested Range Aerial Pesticide Technology. USDA Forest Service, Missoula Equipment Development Center, Missoula, MT.

(2) Training of field personnel was identified as a major need. Training in contract management, contract specifications, spray drift control, pesticide handling, and selection of pesticides. The field identified a need for manuals on herbicide application and favor more training over more research.

(3) Planning. Most field units experienced in aerial spraying recognize the importance of proper planning and communicating with the contractor.

(4) Weather. Collecting and recording weather information is needed for operational control and for documentation purposes. A reliable, portable weather station is needed by the field which records basic weather.

d. Use of Existing Technology.

Environmental concerns over the past several years have focused attention on safe and efficient use of pesticides. Federal, state and local regulations, and pesticide label requirements have made resource managers and their staffs acutely aware of the need for proper application and handling of pesticides. It is probably a safe assumption that field personnel, therefore, are sensitive to the need for proper handling and application of pesticides and managing drift. The greatest interest and need expressed by the field and applicator or FS contractor is implementing methods to manage spray drift. This includes consideration for aircraft performance, spray system specifications, spray behavior, and the spray application prescriptions which combine these factors to manage drift.

(1) Herbicides are usually managed by district personnel in coordination with Range or Timber Staff personnel. Herbicide application, however, is not their primary speciality. Application handbooks are necessary to supplement training in herbicide application. Herbicides have not been aplied in many forests for several years which compounds the need for training. Training also provides an excellent vehicle to bring latest technology to the field.

(2) Insecticide applications traditionally have been handled by FPM pesticide specialists and/or FPM personnel experienced in pesticide use. Because of close communications within FPM, new technology is more easily applied to insecticide control projects. FPM sponsors various types of pesticide application development activities (see Annex B) which have been directed toward advancing FS capability to apply insecticides more effectively and safely. Overall, proficiency in applying pesticides and new technology is greater in those Regions which are close and cooperate with FS R&D activities and/or have experienced a greater number of control projects.

e. Methods to Increase Use of Technology

It is the responsibility of the Regional and Area Pesticide Use Coordinators and the National Pesticide Application Specialist to keep abreast of new technology and to insure that line personnel are likewise kept informed of technology. Neither can we assume that existing or "old" technology is being used to its fullest extent. Through field contacts and discussions with pesticide use coordinators there is an apparent need to continually provide assistance in transferring and implementing aerial application technology.

(1) Communications. There is a need to increase communications between FPM personnel and Range and Timber staff officers. Opportunties exist for FPM specialist to transfer technology through direct involvement in vegetation management projects from planning through project completion.

(2) Training. Formalized training and participation in control projects are needed to maintain individual proficiency, to implement technology, and to maintain a cadre of technical personnel. Training is expecially needed in:

(a) Contract preparation, administration and monitoring compliance.
(b) Developing project plans and specifications.
(c) Drift management technology
(d) Monitoring quality of application and target response.
(e) Aircraft and spray system specifications and performance.
(f) Selection of pesticides.
(g) Pesticide handling, storage, and disposal.
(h) Use of spray models in planning and conducting aerial spray projects and in developing spray prescriptions.

(3) Manuals and Handbooks. In addition to the FS manual series, field handbooks are an excellent media to implement technology. They provide a ready reference for training field personnel and as a reference for the field in preparing control project work plans.

(4) Contracts. Standardizing aerial application contracts would assist field personnel in contract preparation. Standarized formats could incorporate technology which otherwise might be overlooked or unknown to some field personnel.

f. Significant Knowledge Gaps in Aerial Application

The previous paragraphs have addressed primarily progress in and use of aerial application technology. Needs for personnel training and other technology transfer activities have been identified. Following is a listing of knowledge gaps which have been identified based upon findings of this assessment and needs expressed by field personnel. Each deals directly or indirectly with managing spray drift. If spray drift is managed many of the other problems associated with aerial application also will be managed.

(1) Atomization data of registered formulations and spray systems are needed to select proper spray systems and droplet size. Atomization data are essential input to the CBG spray model.

(2) Affects of adjuvants are needed on delivering sprays to the target, reducing evaporation, and controlling drift.

(3) Validation of CBG Forest Spray Model capability is needed as a tool to predict spray drift.

(4) An inexpensive quantitative sampler is needed to detect and to measure spray drift.

(5) A handbook of field prodecures is needed on conducting safe and efficient aerial spray projects for ready reference by personnel conducting field projects.

(6) A method is needed to determine spread factors in the field. Kromekote card sampling commonly used to monitor application and spray drift, relies upon how much spreading occurs on the paper for quantitative data. Atmospheric conditions, existing at time of spraying, affects spreading. If the amount of spreading can be established in the field, quality of deposit data will be increased appreciably.

5. CONCLUSIONS.

a. Use of Existing Technology

(1) The present organizational elements of the FS, which has aerial application technology as part of their mission, seems to be adequate in dealing with FS aerial application needs. The FS role in aerial application technology research and development, that of being alert to new developments, adapting appropriate technological developments to FS needs, and conducting R&D tasks specific and unique to FS needs, is a productive and economic approach to maintaining a capability for aerial application.

(2) The FS has developed a capability to conduct safe and efficient aerial spray operations and is using existing technology. The FS is abreast of current technology; however, transferring and implementing technology to the field needs improvement.

(3) Significant progress has been made to advance aerial application technology since 1978 as outlined in Annex B. Progress can be attributed to FPM commitment to support aerial application technology and to the review Problem Analysis--Forest and Range Aerial Pesticide Application Technology. This Analysis defined FS needs and identified problems for management decisions leading to initiation and funding of new projects and continuation of others.

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b. Methods to Increase Use of Technology

(1) Existing FS organization and staffing (MEDC and FPM Specialists and Staff) are capable of managing an aerial application program. Some adjustments will be necessary, however, to deal with needs identified in this study, particularly in regards to managing drift management and herbicide application.

(2) Training of field personnel is needed to increase use of aerial application technology. There is a continued need for training as new technology becomes available and as personnel are rotated to other assignments. Training is needed in contract administration, aerial spray methodology, monitoring spray projects, and spray drift management.

(3) Field handbooks on aerial application, particularly herbicide application, are needed for training and for reference purposes.

(4) To apply existing technology an in-house capability is needed to provide non-research type evaluations, and service-type work for the field. This includes spread factor determinations, nozzle characterization, adjuvant evaluation, formulation work, spray deposit and analysis, and analyses of drift samples both for insecticides and herbicides.

(5) Assigning a qualified spray strategist to major control projects is an excellent way to transfer and to use existing technology.

(6) Opportunities and needs exist for FPM personnel to expand involvement in herbicide projects. Existing technology used by FS in applying insecticides can be applied to herbicide use projects. Examples include use of a spray strategist, methods to calibrate and characterize spray aircraft, spray deposit assessment, and use of CBG spray model.

c. Significant Knowledge or Technology Gaps

Management of spray drift is a significant technology gap. Methods to sample and assess spray drift, proper use of spray aircraft and equipment, understanding spray behavior and meteorology, and effective use of adjuvants to reduce evaporation are needed to improve FS capabilities to manage drift.

6. RECOMMENDATIONS.

a. Program Management

While the FS organization is adequate there is a need for program coordination consistent with recommendations as set forth in the Analysis. Program objectives, work priorities, budgets, and manpower should be established by the Chief based upon recommendations of specialists in pesticide use and in aerial application technology. Major reorganizations, shifting of missions, and establishing new work groups do not appear to be cost effective approaches to dealing with aerial application problems.

b. Management of Aerial Spray Projects.

(1) Publish field handbooks on aerial application of herbicides and insecticides.

(2) Select and recommend a weather measuring and recording system to obtain weather data for operational support of spray projects.

(3) Assign a spray strategist to major aerial spray control projects.

(4) Incorporate current drift control methods in spray contracts.

(5) Establish a training program for Regions and Forests and develop handbooks on management of aerial application projects and spray drift.

(6) Continue expansion of the CBG Forest Spray Model as a system to plan and conduct safe and efficient aerial spray projects.

c. Aerial Application Contracts

(1) Develop a standard spray aircraft contract and recommend a standard for field use.

(2) Establish a training program for Forest personnel in administration of aerial application contracts. This would include preparation of specifications, contractor/COR communications, contractor compliance, and monitoring performance.

d. Technology Support Centers

Continue current in-house capability at Davis (FPM) and Missoula (MEDC) to provide non-research type evaluations and service type work for direct support of field elements. Specific support is identified in paragraph 5.b.4. The FS has developed a capability of conducting aerial control projects. Our capability probably exceeds that of any other agency. The uniqueness and challenge of conducting safe and efficient spray operations in forests has necessitated the FS to maintain its own research and development activities in aerial application. Changes to present practices run the risk of compromising the FS mission and FS loosing control of its program. Expand the in-house capability if FS expands aerial application use of herbicides.

e. Pesticide Use Specialists

Emphasize, in specialist's performance standards, keeping abreast of aerial application technology, particularly drift management, and transferring this technology to the field.

JOHN W. BARRY
National Pesticide
Application Specialist

Enclosures: Annex A - Background Information Supplemented to Discussion, Paragraph 4.
Annex B - Progress in Aerial Application Technology Since 1978.
Annex C - Summary of Responses from Regions and Areas.
Appendices to Annex C - Copies of Responses from Field.

ANNEX A

Background Information Supplemental to Discussions, Paragraph 4.

to

Assessment of Aerial Application

Most uses of aerial application in the U.S. are in agriculture. Technology for aerial application was developed primarily for agriculture. USDA scientists in the Agricultural Research Service, agricultural universities, and industry have produced the methodology and hardware for aerial application.

Technology for aerial treatment of forest lands has been developed by the FS and its cooperators. The applicator's market for application of pesticides to forests is limited. As a result the FS must go it alone and fund for research, development, and technology transfer. A recent example is SA and FPM developing methodology to apply pesticides to seed orchards. Faced with unacceptable losses of seed crops and failure of conventional control methods, the FS responded quickly to establish methodology for effective use of aircraft in orchards. Through the years a modest but consistent FS program has funded aerial application technology to deal with forestry problems.

Based on my perspective of 10 years associated with the FS aerial application control program I believe the FS can take pride in management and accomplishments of its aerial application program. The FS has steadily progressed toward safer and more effective use of pesticides. We now are able to specify aircraft, spray systems, pesticides, and spray strategies which will give a high probability of achieving FS objectives. This was not the case 10 years ago. Aerial application, on the other hand, has been an insignificant element of the FS budget. The success of the program can be attributed in part to alert engineers and scientists who have adopted existing technology to FS requirements and to FS management for funding projects unique to forestry needs.

Aerial application technology within the FS can be categorized into four functional areas; research, development, technolgy transfer and control operations. The key, however, to a successful research and development program and to successful control operations relies upon staff and coordination activities of pesticide use specialists in the Regions and Areas and the National Pestcide Application Specialist. These specialists initiate R&D requirements based upon observed needs through direct contact with the field, identify and coordinate training needs; identify and report research and development needs; and remain alert to, and introduce, new technology to the field.

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The present organizational elements of the FS, which has aerial application technology as part of their mission, seems to be adequate in dealing with FS aerial application needs. While the organization is adequate there is a need for program coordination consistent with recommendations as set forth in the Analysis. Program objectives, work priorities, budgets, and manpower should be established by the Chief based upon recommendations of specialists in pesticide use and in aerial application technology. Major reorganizations, shifting of missions, and establishing new work groups do not appear to be cost effective approaches to dealing with aerial application problems.

The FS and the forest industry have unique aerial application technology needs. While other groups, both in the public and private sectors, can rely upon the agricultural community, pesticide manufacturers rely upon USDA and university extension activities for aerial application technology. Forestry personnel must call upon their own resources to deal with forest related application problems. Aerial applications to forests, particularly in the west, is recognized as a very complicated operation. Most conditions favor spray drift such as complex atmospheric conditions, rugged terrain, and elevation. The forest manager generally is more concerned about environmental impact than the farmer. The forest environment provides a haven for many plant and animal species which could be affected by pesticides. Most forests usually are managed on a multi-use concept. These factors complicate forest spray operations. The uniqueness of aerial application problems to forestry dictates that the organization responsible for productive management of the range and forest also be responsible to obtain and apply technology for safe and effectve application of pesticides.

The thrust behind agricultural aerial application technology is in the USDA-ARS and cooperative extension programs based throughout the land grant system. This is an establishment with a long tradition of providing technology based upon regional needs. ARS conducts no agricultural control spraying of its own.

USDA-APHIS, with a broad chapter of dealing with insect pests, sponsors and sometimes conducts in cooperation with the States, large scale control projects, i.e., mosquitos and vectors in Texas, Medfly in California and Florida, grasshoppers in the West, and gypsy moth in the East.

By contrast the FS has R&D organizations and specialists working on application technology. As discussed previously the FS has a strong technological base in application. There is probably no organization in the US, Federal or State, (with the exception of Maine) with a knowledge base and technological capability in aerial application comparable to that of the FS. Therefore, the FS probably has more technology to share with other users than may be available from ARS or APHIS.

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ANNEX B

PROGRESS IN AERIAL APPLICATION TECHNOLOGY SINCE 1978

to

Assessment of Aerial Application

Upon the recommendation of the Director, Forest Pest Management, the Chief appointed a working group in January 1978 to: Review the state-of-the-art in aerial spraying; to develop a comprehensive document delineating forest and range aerial application problems and make recommendations to solve the problems; and to determine the relative importance of these problems for groups funding or contracting aerial application research and development. Findings were reported in A Problem Analysis Forest and Range Aerial Pesticide Application Technology dated July 1978, published by Forest Service Missoula Equipment Development Center, Missoula, MT.

The Analysis served several useful purposes. It provided an opportunity for the Forest Service to formally assess its capability in aerial application of pesticides. It provided an opportunity for staff groups (Forest Pest Management, Research, and Engineering) to evaluate common problems. The major benefit was in defining the complexities of aerial application in an approachable manner for resolution.

Although no formal aerial application program resulted from the Analysis and its recommendations, considerable progress has been made in aerial application technology by FPM funded projects, MEDC, FI&DR, and CANUSA. The Analysis, simply by defining the sub-problems into units, provided an organized

format for on-going and new projects. Bearing in mind that the FS goal in aerial application is for safer and efficient aerial application of pesticides, the Analysis served the purpose of providing a format or blueprint leading to this goal.

Following is a list of the sub-problems and a summary of progress which has been made since the study was published in July 1979.

1. Aircraft Delivery Systems

a. DESCRIPTION (SIZE AND NUMBER) OF SPRAY DROPLETS, REPRESENTING DIFFERENT TANK MIXES, EMITTED FROM SPRAY NOZZLES.

Progress. FPM and CANUSA supported projects are underway at University of California (Davis) and Colorado State University (CSU) to obtain this information on selected tank mixes. MEDC is serving as COR representative for CSU project and FPM/MAG for the UCD project.

b. TECHNOLOGY FOR ESTABLISHING BOOM LENGTH AND NOZZLE LOCATION.

Progress. Data on nozzle types, location, and boom length for several aircraft and tank mixes have been obtained in the field and reported. Also, through MEDC and FPM efforts, a NASA model which evaluates nozzle configurations on spray booms will be available for FS use.

c. NOZZLES PRODUCE TOO MANY SMALL DROPLETS WHICH CAUSE DRIFT AND TOO MANY LARGE DROPLETS WHICH ARE INEFFICIENT.

Progress. Wind tunnel and field tests, supported by FS cooperators, have helped to define the droplet size problem. The optimum droplet spectrum for maximizing deposit on the various targets is better understood due, in part, to this work. Field procedures which help to reduce the fine and large droplets are being used on some control projects. Pre-spray calibration and characterization of equipment to insure proper droplet size are routine procedures for insecticide projects. No further progress can be made on further reduction of fine droplets until industry develops spray systems and formulates additives which will produce limited drop size spray.

d. STANDARDS FOR SELECTING SPRAY AIRCRAFT.

Progress. By working closely with Regions, Areas, and cooperators we have obtained spray aircraft performance data on several models of spray aircraft. Procedures in aircraft calibration and spray characterization have become routine on most insecticide application projects. This has resulted in a significant boost in monitoring contractor compliance. Also these procedures have materially increased the quality of aerial application projects.

2. Aircraft Guidance

METHODS OF GUIDING SPRAY AIRCRAFT DURING SPRAY OPERATIONS.

Progress. FPM, MEDC, CANUSA, FI&DR and cooperators have evaluated electronic guidance systems. None has proven satisfactory in western mountains. In the West, chase aircraft are being used effectively to assist spray aircraft in locating spray blocks and maintaining even swaths. There

are questions whether electronic systems are practical for use in mountainous terrain. In the East the LORAN-C system is satisfactory for large aircraft operating over large target areas; however, even there, chase aircraft also are deployed.

3. Application Strategy

FRAMEWORK TO ORGANIZE INFORMATION AND TO DEVELOP A STRATEGY FOR PLANNING AND CONDUCTING AERIAL SPRAY PROJECTS.

Progress. In 1980 FPM/MAG put the Forest Service Cramer/Barry/Grim (CBG) Forest Spray Model on-line at the USDA Ft. Collins Computer Center. This model provides a framework which organizes all information needed to plan and to evaluate options for safe and efficient aerial application. Input options are sorted by the model providing output for decisions on spray atomization, and evaporation, spray drift, and application methods. This is the first model of its type in the US which is operational. Presently the Forest Service is dependent upon a contractor for application of this model. Critical personnel, trained and experienced in the use of this model, are leaving the Forest Service due to transfer of FPM/MAG function to Ft. Collins. Future use of this model is dependent upon a professional (FS or contractor) to use the model for operational projects. The former seems a more realistic option.

In 1979 a contract was awarded to Ketron, Inc. to develop a systems approach to aerial application. Using the CBG model as a base system, the contract will set forth an approach for further expansion of a model-based decisionmaking tool.

4. Biological and Aerial Application Technology Interface

INFORMATION ON RELATIONSHIP AND INTERACTION OF THE PESTICIDE, ENVIRONMENT, WEATHER, AND HOST ON THE TARGET PEST OFTEN HAS RESULTED IN VARIABLE AND UNEXPLAINABLE RESULTS, PARTICULARLY WITH BIOLOGICAL AGENTS.

Progress. PSW has conducted experimentation to obtain information on the relationship of insecticide doses to insect mortality. Natural resistence of wild populations to specific pesticides also has been investigated. A model has been developed which predicts mortality as a function of doses, larval size, etc. Eventually the PSW model can be used either in conjunction or combined with the CBG model to plan control projects. Discussions have been held with Jackie Robertson and Carroll Williams about PSW/FPM cooperative testing of the two models.

5. Meteorology

THRESHOLD REQUIREMENTS FOR AERIAL APPLICATION HAVE NOT BEEN DEFINED ADQUATELY, NOR CAN THEY BE RELATED TO EITHER SYNOPTIC SCALE CLIMATOLOGY AND FORECASTS OR TO ON-SITE MEASUREMENTS IN NON-UNIFORM TERRAIN.

Progess. Spray meteorology incompasses the most complex aspects of spraying. The FS has wrestled for years on what meteorological measures should be made in the field, where they should be made, and with what instrumentation to support control projects. We have come to the realization that for pilot and operational control projects, measurements and recording of wind speed, wind direction, temperature, and relative humidity, at appropriate location, are sufficient to support control projects. Use of a spray

strategist, experienced in mountain meteorology and spray behavior, supported by limited meteorology measurements, is the most effective way of integrating meteorology with project management. Spray strategists are now recommended for control projects using insecticides. Field experiments involving the pesticides, meteorological, and drift studies may require more sophisticated instrumentation and measurements.

6. Pesticide Safety

STANDARDIZE PROCEDURES AND METHODS FOR PROTECTING PERSONNEL ON PILOT AND OPERATIONAL CONTROL PROJECTS.

Progress. Forest Service published Pesticide Safety--Guidelines for Personnel Protection in 1980. This publication provides a ready reference of standardized guidelines for personnel planning, conducting, and working on pesticide application projects. This publication should satisfy problems identified in the review.

7. Spray Behavior

QUANTIFY PHYSICAL BEHAVIOR OF SPRAY DROPLETS FROM ATOMIZATION TO DEPOSITION OR VAPORIZATION.

Progress. Most of the recommendations have been accomplished or work has been initiated.

a. CBG Model has been selected to predict both spray deposition and spray drift. It is operational and available on the USDA computer.

b. Through an FPM/MAG contract CBG model has been modified to

accept evaporation. This advances FS capability in accounting for spray drift. Evaporation rate of selected tank mixes has been determined by another contractor through support of CANUSA, FPM and MEDC.

c. CBG model has been field tested on two projects. It was used to predict spray penetration of a seed orchard canopy and to quantify the amount of spray drifting beyond the orchard. In another test a FPM/MAG contractor conducted a drift study in complex mountainous terrain to validate the ability of the CBG model to predict drift resulting from treatment to steep mountain slopes. A report will be submitted by the contractor in December 1981.

d. MEDC has a contractor designated to evaluate one adjuvant to reduce evaporation. This is an FPM funded project which is near completion.

8. Spray Drift

THERE ARE THREE PARTS TO THIS PROBLEM:

a. PROJECT MANAGERS ARE NOT APPLYING ALL AVAILABLE TECHNOLOGY TO REDUCE PESTICIDE DRIFT OUTSIDE TARGET AREAS.

b. LACK OF MONITORING DRIFT OUTSIDE SPRAY AREAS.

c. PUBLIC HEALTH OFFICIALS HAVE NOT ESTABLISHED PESTICIDE THRESHOLDS WHICH ARE NEEDED TO SELECT AND/OR DEVELOP DRIFT DETECTORS.

Progress. MEDC is evaluating inexpensive impaction samplers to detect spray drift. One design is ready for field evaluation. Spray strategists, when assigned to spray projects, have contributed to drift reduction by applying knowledge and experience in real world situations.

evaporation. This concern of capability in accounting [illegible] survey [illegible] evaporation [illegible] selected tank mixes has been determined [illegible] another [illegible] through [illegible] of [illegible], FPM and MEDC.

c. [illegible] have field tested on [illegible]. It [illegible] spray penetration [illegible] guard can [illegible] [illegible] of spray [illegible] [illegible] tes [illegible] tractor [illegible] a [illegible] complex [illegible] [illegible] ability of the [illegible] model [illegible] drift resulting from treatment on mountain slopes. [illegible] will [illegible] submit [illegible] the [illegible] [illegible] 19[illegible]

d. [illegible] [illegible] vaporation. This [illegible] [illegible]

Drift

THERE ARE THREE PARTS TO THIS PROBLEM:

a. [illegible] APPLY [illegible] ALL AVAILABLE [illegible] PESTICIDE DRIFT OUTSIDE TARGET AREAS.

b. LACK [illegible] MONITORING DRIFT OUTSIDE SPRAY AREAS.

c. PUBLIC HEALTH OFFICIALS HAVE NOT ESTABLISHED PESTICIDE HOLDS WHICH ARE NEEDED TO SELECT AND/OR DEVELOP DRIFT DETECTORS.

[illegible]. MEDC is evaluating inexpensive impaction samplers [illegible] spray drift. [illegible] design is ready for field evaluation. Spray [illegible] assigned to spray projects, have contributed to drift [illegible] applying knowledge and experience in real world situations.

9. Spray Sampling

USE OF EXISTING METHODS TO IMPROVE SPRAY SAMPLING.

Progress. MEDC and FPM/MAG have evaluated several deposit papers to detect undyed oil and water base sprays. We can recommend detection papers for some undyed tank mixes. On another project FPM/MAG reported on statistical differences resulting from a reduced level of deposit tree sampling. Results demonstrated that we can use fewer deposit cards at sample tree clusters. Spray sampling methods also have been deeloped to obtain correlations between spray deposit and insect mortality.

10. Technology Transfer

EXISTING TECHNOLOGY IS NOT BEING USED TO THE EXTENT POSSIBLE TO IMPROVE PLANNING AND TO CONDUCT OPERATIONAL SPRAY PROJECTS.

Progess. FPM and MEDC reports which have supported technology transfer include:

a. Methods for Sampling and Assessing Deposits of Insecticidal Sprays Released over Forests. (Published prior to Review).

b. Field Manual for Characterizing Spray from Small Aircraft. (Published prior to Review).

c. Pesticide Safety--Guidelines for Personnel Protection.

Spray Sampling

As part of technology transfer FPM and MEDC specialists have been active in providing consultations on aerial application to the field through telephone requests, workshops, seminars and on-site assistance seminars. Articles have been published in trade magazines and professional journals. Lectures also have been delivered to groups responsible for aerial application activities. FPM/WO has initiated a national pesticide certification program for Forest Service personnel, ~~and has outlined an all inclusive program to train and qualify Forest Service personnel in managing aerial spray projects.~~

ANNEX C

SUMMARY OF RESPONSES FROM REGIONS AND AREAS

to

Assessment of Aerial Application

A letter was sent to Regions 1-6, 9, 10, NA and SA, during April 1981, requesting identification of problems associated with application of insecticides and herbicides, and suggested solutions. Responses were received primarily from Forest Staff Officers and District Rangers representing all Regions and Areas except R-4 and R-10. These are attached as Appendices to this ANNEX.

REGION/AREA	PROBLEMS AND COMMENTS
1. R-1, FPM	a. Problems develop when inexperienced personnel direct projects i.e., selection of pesticides, calibrating equipment, use of adjuvants, equipment performance, and influence of weather on efficacy.
	b. Need delivery systems to reduce off-site drift including aircraft design modification and reducing aircraft vortices.
	c. No problem with full service contracts if contract is awarded to quality contractor.
2. R-2, FPM	a. Need training to maintain proficiency in aerial application; possibly by placing greater emphasis on identifying detailers to spray projects. This would help to maintain a cadre for aerial application projects and for career development.

b. Need formulation work to extend and evaluate adjuvants. This is based upon need to prolong pesticide activity, extend rain fastness, screen UV rays, etc. Suggest field testing adjuvants through cooperation of FPM/MAG, PSW, and pesticide manufacturers.

3. R-3, FPM (Parker) a. Opposed to full service contracts because of need to maintain quality control.

b. R-3 feels they are well aware of, and are using, existing technology.

4. R-3, (Hofacker) a. Contractors arriving on-site and not prepared to meet contract specifications is a problem.

b. Need a simple calibration procedure for field personnel to follow.

c. Need to know a great deal more about formulations and additives.

d. Aircraft guidance is a problem in both insecticide and herbicide applications.

5. R-3, Range (Dalen) a. Need to get technology to field and need to conduct field training on aerial application.

b. Need procedures and data on spread factors of herbicides.

c. Need a briefing paper on spray model and how to use the model to improve field projects.

d. Need aircraft characterization procedures for herbicides.

e. Need to publish aerial application handbook (this has been contracted to MEDC and UCD).

6. R-5, Los Padres NF a. Need updated handbook with current reference information on herbicide application presented in a clear, practical, and useable format which project supervisors and crews can understand. This would be a significant step toward solving aerial application problems without doing in-house research and development.

b. Detailed pre-work conferences and daily project conferences preclude contract problems. Considerations of aerial application--drift, additives, application strategy, calibration, meteorology, etc., are part of project planning.

c. Full service contracts have led to problems in pesticide handling and storage. FS crews can handle pesticide handling and storage more effectively than contractor.

d. Aircraft contracts should be written in relationship to desired results rather than aircraft type.

e. Forests should emphasize importance of having a qualified helitack foreman on all aviation projects. Foreman should have basic training in spray aircraft equipment, performance, and application.

7. Angeles NF — No Spraying past four years.

8. San Bernardino NF

San Gorgonio RD a. Contracts should be all-inclusive and in-depth. A strong COR is important and should be given adquate authority.

b. Spray drift occurs on most projects because conditons in RD generally favor drift.

c. Full service contracts would be a mistake.

9. Cajon RD a. Improvement needed in pre-work communications with contractors. Need inspections by zone personnel. Contracts should be standardized.

b. Consider same contractor for herbicide retreatments. This would help in special drift/terrain problems by having a pilot, experieince with the site, doing the treatment.

c. Problems with contractor compliance in proper handling pesticides, i.e., ordering, storage, mixing, etc.

d. Need to insure that contractors with sub-standard performance on other contracts, are not awarded other contracts, even though they are low bidder.

e. Need to inspect operator's equipment before it arrives on site or before contract is awarded. A full service contract would be appropriate from those with proven performance.

f. Need better meteorological instruments in field to record weather critical to spraying. Fire weather kits are not appropriate for wind measurements because they are not recorders.

g. Need to know application procedures which will help to minimize drift. Also need contractors who use drift control equipment.

10. Cleveland NF

Palomar RD

a. Spray pilots are taken on aerial survey prior to projects by Project Officer describing sensitive areas.

b. Full service contracts are not used and will not be in the future. With this contract FS looses control but still has responsibility.

c. Procedures to insure spray equipment performance, including calibration and spray atomization checks, should be included in contract.

11. Mendocino NF a. Need regional (office) personnel whose only job (specifically) is verification, monitoring, evaluation, documenting, and training in pest control, especially vegetation management.

b. Problems with contractor compliance, i.e., getting applicator to site and spraying during favorable spray weather.

c. Need radio communication, ground to air, for control of spray helicopter.

12. Plumas NF a. Need to design a comprehensive refresher course on aerial application of herbicides as a priority job for MAG.

b. Next priority would be to develop methods to minimize spray drift.

c. Need to emphasize project planning and evaluation, and training in calibration.

d. Need clarification on definition of full service contracts.

13. Shasta-Trinity NF a. Contracts should specify how to apply pesticides, weather limitations, and type spray boom.

b. Stress communications between project officer and pilot, identify senstive areas, and discuss how to manage drift.

c. Need to implement procedures to insure spray equipment performances, calibration and characterize spray atomization.

d. Raindrop nozzles and microfoil booms seem to work well in reducing drift and are recommended; therefore see no need to spend (FS) time and money attempting to make improvements.

e. Minimize drift by specifying relative humidity in contract, nozzles and type boom, and application methods.

f. Full service contracts may be necessary in future due to manpower shortages. Consideration should be given to contractor (assume contractor other than the applicator) doing water monitoring under the full service contract.

14. Sierra NF a. Some concern at RD level that planning aerial applications projects is too complicated and time consuming. Planning for a 1 day job may require 1-2 months of planning.

b. Costs are high ($60/A) compared to $30/A for tractor spraying. Acreages greater than 500 are needed to make aerial spraying with herbicides cost effective.

c. Prefer full service contracts; however, container disposal is done usually by FS.

d. Weather measurements and recordkeeping are important to deal with possible lawsuits resulting from drift. As a minimum record; wind speed, wind direction, temperature, and relative humidity at least for each spray load.

e. Helicopter should spray close to vegetation but no higher than 50 feet.

f. Spray-thickening agents should be used in tank mixes for all herbicide applications (air, tractor, or hand spray).

g. FS must present to the public a united (professional) front to satisfy their fears about use of herbicides and that we can do the job safely.

15. Klamath NF a. Have contract specification and compliance problems, i.e., contract arriving late on site, costing FS time and money due to delays. Klamath, however, prefers full service contract.

b. Need research data to support spraying under higher wind velocites.

16. R-6, FPM a. Need to tune up skills and knowledge in monitoring contractor compliance. Need a state-of-the-art review with recommendations of publications to consult and appropriate methods to check contractor compliance.

17. R-6, Timber

a. Need method to monitor contract compliance and a way to determine if the job was accomplished.

b. Need a uniform procedure in the Region for post treatment monitoring (target affects).

c. Full service contract is a valuable tool. The key to its effectiveness and reliability lies in the contract language (specifications) and in the qualifications of those (COR) performing compliance checks.

18. R-6, Range

a. Full service contracts are a valuable tool. With a set of good stipulations and a capable, conscientious inspector to enforce it, this type contract is an excellent tool.

19. R-6 (Gross)

a. What is the latest aerial application technology? Seems there is a problem in putting new methods into practice--getting it into hand of the user.

b. Need data to substantiate (provide confidence) in procedures being used.

c. Have problem in administering contract. Need training in this area.

d. "We do have a concern about droplet size and numbers. What is actual size and distribution of droplets in actual operations; and actual effect of using the raindrop nozzle? PNW publication states the hollow cone D8-46 nozzle is the best combination for herbicide application based on coverage. What is the droplet distribution and numbers? We need this type of information so that we can specify the proper nozzle for our conditions and so that we have data to support our actions to the public. Presently we tell the public that we use the raindrop nozzle and/or low drift additive to control drift. We question to what extent do the raindrop nozzles actually control drift under field conditions and are they really needed."

e. "The full service contract is a good approach to accomplishing our task. The only minimizing of Forest Service involvement is that we are not required to inspect the helicopter. We do not use the aircraft for recon or fly in it for any reason thus it can be a restricted use aircraft and only needs to meet FAA standards. If the contractor supplies the pesticide the requirements are spelled out in the contract. To insure that the wrong area is not sprayed, we provide good maps and aerial photos plus identify the areas on the ground. We also have an observer in each spray area so that he can help guide the pilot to the area."

f. "Need an application manual for herbicides. Bits and pieces of information are scattered throughout research and a few forests or regions. It seems that each user is doing the job in his own way and has no other knowledge of how the job can be done. The only training available is through state certification programs for restricted use

pesticides. In this area the training pertains more to row crops and does not necessarily fit the forest environment. The fact is that we are not using restricted use herbicides in our aerial programs and therefore this training is not required."

There may be standards and guidelines printed but we are not aware of them. Region 6 developed an applicator's manual that was to be adapted for nationwide useage. What has happened to this publication? We need this type of information but it does no seem to be available."

I visualize this handbook as a package that not only covers the aerial application but contains information to help select the proper nozzle or combinations, boom length considerations and other information that is necessary to properly plan and accomplish a good, safe, and sound aerial application program."

"Referring to my first paragraph, a technology transfer system is needed in pest management. We feel that we are using the latest technology but we are not sure of this fact as we do not have access to the latest information. The information needed is located in many different places and is exceedingly difficult to obtain." (Quoted from Larry Gross).

20. Southeast Area a. Problem in getting applicators to bid on seed orchard application projects. FS needs to communicate and work with cooperatives and aerial applicators about seed orchard needs.

b. Recommendations and specifications (prescriptions) for seed orchard treatment should be consistent. Need a step-by-step format for seed orchard managers to follow.

c. Need to evaluate cost-effective methods of treating orchards by aircraft (rates, swath width, aircraft speed, etc.). Current procedures are based upon results of limited field demonstrations.

d. Need to monitor and document drift, or lack of drift, on all spray projects.

e. Need open and complete communications between pilot and project officer. Pre-spray briefings must include identifying sensitive areas.

21. Northeast Area a. Problems due to public opposition to pesticides, poor application techniques, poor contract preparation and administration. Need to train personnel in the above.

b. Communications between pilot, other contract personnel, project directors, and field technicians are essential in dealing with drift.

c. Need methods to detect changes in weather factors which affect drift, and to relay compensating instructions quickly to pilot.

d. Need training in contract preparation and contract administration. Contract personnel also need training in FS pesticide application. COR must be trained in calibration and in identifying weaknesses (malfunctions) in spray systems.

e. Full service contracts can work but important to properly develop contract specifications and performance standards, and to administer the contract.

United States Department of Agriculture
Forest Service
FPM/MAG
2810 Chiles Road
Davis, CA 95616

Reply to: 2150 Pesticide Use, Management and Coordination

Date: April 15, 1981

Subject: Assessment of Aerial Application Technology

To:

Bill Stewart, R-1
George Downing, R-2
Doug Parker/Ray Dalen, R-3
Don Curtis, R-4
Brian Sturgess, R-5
✓Randy Perkins, R-6
Bob Averill, R-10
Charles Hatch, NA
John Taylor, SA

The Director, Forest Pest Management, WO, has asked me to assess how well the Forest Service is utilizing the latest technology in aerial application of pesticides. The assessment will be oriented toward technology which will advance our capability to apply pesticides safer and more efficiently. It will identify what we believe are the most serious knowledge gaps and recommend actions for resolution.

The FS aerial application technology program, over the next few years, will emphasize utilization of existing technology to deal with major aerial application problems. It does not appear that funding, above present level, will be available for in-house research and development.

Given this broad background I would appreciate your comments. What are the problems associated with aerial application of insecticides and herbicides in your region or area and what suggestions do you have toward their solutions?

Following is a partial list of items in which I have special interest:

1. Spray aircraft specifications, contract performance, and contractor compliance.

2. Improvement of communications between project officer and spray pilot including briefing on drift control, avoidance of sensitive areas, etc.

3. Project planning and evaluation.

4. Procedure to insure spray equipment performance including calibration and characterize spray atomization.

Bill Stewart, R-1
George Downing, R-2
Doug Parker/Ray Dalen, R-3
Don Curtis, R-4
Brian Sturgess, R-5
Randy Perkins, R-6
Bob Averill, R-10
Charles Hatch, NA
John Taylor, SA

5. Methods to minimize spray drift -

   a. Meteorology.

   b. Application methods.

   c. Special equipment.

   d. Formulations and additives.

Please also give me your thoughts on the full service type contract. This contract, as I understand it, minimizes direct FS participation. It seems to me that such open contracts have a potential for situations leading to embarrassment to the FS and I therefore seriously question the rationale and use of the full service contract for projects involving pesticides. Examples of potential problems might be off target drift, spraying the wrong target, label violations, etc.

I would appreciate your response by middle June. This is an opportunity for us to let our views, concerns, and ideas be heard. Thanks in advance for your cooperation.

JOHN W. BARRY
National Pesticide
Application Specialist

JUN 26 1981

United States Department of Agriculture | Forest Service | R-1

Reply to: 2150 Pesticide Use, Management and Coordination Date: June 19, 1981

Subject: Assessment of Aerial Application Technology

To: William L. Ciesla, FPM/MAG

This is Dr. Stewart's response to John Barry's letter of April 15 concerning aerial application assessment. The following items seem pertinent to the issue:

1. Aerial application of herbicides sometimes present problems when newer, more inexperienced personnel direct projects. Specific problem areas include proper selection of chemicals to be used, inability to calibrate, little knowledge of nozzle differences and other special equipment, and lack of knowledge concerning use of adjuvants and weather influence on efficacy. These problems can be reduced through education, either by training sessions or information publications.

2. Development of improved delivery systems to reduce off site drift. This includes aircraft design modification and the reduction of influence by vortices.

The issue of full service contracts is timely. As we all know, there is tremendous quality variation by applicators. Those having the knowledge, capability, and a history of providing quality service present no problem. There is, however, a potential for misapplication and embarrassment to the Forest Service when lesser qualified applicators perform services.

There should be an effort made to utilize and incorporate information from other aerial application problem-solving efforts. One suggestion is incorporation of information produced by Dr. Ellis Huddleston of New Mexico State University at Las Cruces.

D. E. Pierce

for DONALD A. PIERCE
Director of Forest Pest Management

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

R-2

REPLY TO: 2150 Pesticide Use Management and Coordination July 14, 1981

SUBJECT: Assessing Aerial Application Technology

TO: Director, Methods Application Group

This is in response to Jack Barry's request to identify needs in aerial application technology.

In Region 2 we have been a fairly small user of pesticides, with few aerial applications. Because of this low level of pesticide useage we have relatively few within Region opportunities for our personnel to gain experience and to remain qualified for aerial application projects. To maintain proficiency and to keep abreast of latest aerial application technology requires detailing individuals to spray projects in other Regions or Areas. Perhaps there should be a greater emphasis on identifying detailers to spray projects for specific assignments. This is important not only from the standpoint of maintaining a cadre of qualified aerial spray personnel, but is also important to individual career development.

One of the most common problems of spray projects is pesticide formulation. In an attempt to prolong pesticide activity, to prevent washing after application, to screen out ultra-violet rays and other factors, the companies and the users have constantly changed pesticide formulations. This is particularly true of pilot projects. Oftentimes these formulations have not been adequately tested prior to large-scale pilot tests or operational spraying. Formulation problems cause serious delays in mixing, failures in spray application equipment and all too often account for erratic or poor project results. There is need for close consultation between MAG, PSW Station, the pesticide companies and perhaps others, to resolve formulation problems prior to pesticide projects. This may require advance field tests of new formulations. Pilot and operational projects have become extremely expensive in both time and dollars and formulation problems must be resolved well in advance of projects.

There are undoubtedly many other needs that you have identified, but I believe these two needs are especially important.

G. L. DOWNING
Director, Forest Pest Management

[illegible]
[illegible]

[illegible] Pesticide Use Management [illegible] Coordinators [illegible]

Processing Aerial Application [illegible]

[illegible], Methods Application [illegible]

[illegible]
technology

[illegible]

application technology
in other Regions
[illegible]

[illegible] This is particularly [illegible] these formulations have [illegible] adequately [illegible] pilot tests or operational spray [illegible] delays in mixing, failures in spray application programs [illegible] often account for overall poor project results [illegible] close consultation between [illegible] and perhaps others, to resolve formulation problems prior to [illegible] projects. This may require advance field tests of [illegible] pilot and operational projects have become extremely expensive, both time and dollars [illegible] advance of projects.

There are undoubtedly many other needs that you have identified, but these two needs are especially important.

United States Department of Agriculture | Forest Service | R-3

JUN 11 1981

Reply to: 2150 Pesticide Use, Management, and Coordination

Date: JUN 9 1981

Subject: Assessment of Aerial Application Technology
(Your ltr. 4/15)

To: Group Leader, MAG

I believe you are well aware of the technology we are using to aerially apply insecticides in the Southwest. I do not know of any problems I need to present to you.

I would like to say that I am not in favor of using full service contracts for aerial application of insecticides. I believe we need to closely control applicators to insure we are getting the quality of work we need.

DOUGLAS L. PARKER
Director of Forest Pest Management

United States Department of Agriculture | Forest Service | RO

R-5

Reply to: 2150 Pesticide Use, Management and Coordination

Date: June 2, 1981

Subject: Assissment of Aerial Application Technology

To: Jack Barry, MAG-Davis

No formal review of pesticide spray operations has been conducted in this Region.

Rather than convey to you our impressions, second hand, we have enclosed the information of those forests responding to our inquiry of April 22 regarding this subject.

Please do not hesitate to contact me or any of the respondents directly if we can be of any further assistance.

Brian Sturgess

BRIAN STURGESS
IMP Technical Assistance Group Leader

Enclosures

United States Department of Agriculture | Forest Service | Los Padres NF

Reply to: 2150 Pesticide Use, Management & Coordination Date: May 14, 1981

Subject: Assessment of Aerial Application Technology (Your ltr 4/22)

To: Regional Forester

This is in reply to your letter of April 22. A general comment on this subject is that there is a great deal of information in various publications, technical guides, etc. on the aspects of aerial application of pesticides. The Operation Guide for Aerial Application of Herbicides Handbook, R5, February 1976, needs to be updated with the current information referenced above. If this information is provided in a clear, practical, and useable format that the project supervisor and crew can understand, it will be a significant step in solving aerial application problems without doing in-house research and development.

My concerns in Item I are handled on the Los Padres with a very detailed pre-work conference as well as with a daily project conference. A qualified foreman of a helitack module is responsible for the daily safety and maintenance part of the contract. The contractor and the Forest Service each know exactly what is expected from one another and who to contact to resolve a problem at any time the project is under way. South Zone Air Unit reviews the draft contract and inspects the ship for contract compliance.

Some of the concerns in Item 2 are covered in Item I. The project officer and pilot have a reconnaissance flight which shows where the project and sensitive areas are located. The pilot, project officer, and project crew are in constant radio communication with each other. A briefing on drift control that covers the subjects under Item 5 is given to all personnel.

Item 3 is covered by a thorough review of the planning and evaluation section of the 1976 R5 Aerial Herbicide Application Handbook.

Equipment such as calibrated cans and oil sensitive spray cards are used before and during the project to insure the proper application rate and spray automization. Paying attention to inversion layers, thermal layers, wind speed and direction, and relative humidity will minimize drift. Application methods such as flying height and speed, droplet size and distribution, boom pressure and nozzle placement are used to control drift. The Amchem MICROFOIL boom or application equipment that uses this principle is useful to control droplet size and distribution. Formulations of water in oil or oil in water and additives such as Lo-Drift or Nalco-Trol that increase the spray mixture viscosity are effective in drift control, also.

We define a full service contract as one in which the contractor is responsible for the purchase, shipping, transportation, storage, and disposal of drums of the herbicides for the duration of the project.

From our experience we have not had the tight control essential in these areas. The wrong chemical, improper EPA registration, poor transportation and storage (in town and leaking drums) were problems encountered. Perhaps with a tighter contract these problems could be reduced or eliminated. Due to the extreme sensitivity with these chemicals, the time and effort the Forest Service crew spends in these areas is well worth it.

The 1976 Handbook is a good place to begin in adding to and utilizing the latest technology in the aerial application of herbicides.

FREDERIK G. deHOLL
Forest Supervisor

United States Department of Agriculture
Forest Service
Los Padres National Forest
42 Aero Camino
Goleta, California 93117

Reply to: 2150 Pesticide Use, Management & Coordination Date: May 20, 1981

Subject: Assessment of Aerial Application Technology (Your ltr 4/14)

To: Regional Forester

This is an additional reply to your letter of April 14, 1981, from the standpoint of the air operations and pesticide application. Our earlier reply was dated April 22, 1981.

In Item I, aircraft specifications should be written in relation to desired results rather than type of aircraft. We have done many spray projects and think that our contracts are written to obtain desired results as well as to work with a helicoptor that meets our needs on the ground and in the air.

Aircraft specifications should reflect the majority of items included in Division 100 of our Regional Fire Helicopter Contracts. The South Zone Air Unit helps us in this field.

A qualified helitack foreman familiar with Forest Service aviation policy should be assigned to each operation to manage the aviation portion of the project. Forests should emphasize the importance of having a qualified helitack foreman in all aviation projects and not just fire suppression. This has been a problem in the past. Since most of our projects deal with fuelbreaks, fire suppression and fuel management personnel play a key role in our projects, and this is not a problem now.

Helitack foremen should have some basic training in spray aircraft equipment, performance, and application prior to the start of an operation. On our current projects, we try to use a foreman with past experience as well as a trainee foreman.

Erwin A. Mandl
for FREDERIK G. deHOLL
Forest Supervisor

U.S. DEPARTMENT OF AGRICULTURE

SPEED MEMO

PART NUMBER	DATE
1	May 14, 1981

TO

Brian Sturgess, Executive Secretary, IPMWG

SUBJECT 2150

Assessment of Aerial Application Technology

FROM

Chuck Reeter, Forest Hydrologist
Angeles N.F.
150 South Los Robles Av.,Pasadena CA 91101

MESSAGE *(WRITE CONCISE MESSAGE. SIGN AND FORWARD PARTS 1 AND 3 TO ADDRESSEE. RETAIN PART 2.)*

In response to R.O. memo of April 22, 1981, the Angeles N.F.'s last aerial application of pesticides was four (4) years ago and none are planned in the near future. We feel that any suggestions from us at this time would be outdated.

We are enclosing a short report written by Joe Gonzales, Watershed Technician, as he is involved on the spray projects at the water quality monitoring level.

cc: Joe Gonzales

SIGNATURE

Chuck Reeter CHUCK REETER, Forest Hydrologist

REPLY *(USE THIS SPACE FOR REPLY. SIGN AND DATE. RETURN PART 3 TO SENDER. RETAIN PART 1)*

SIGNATURE	DATE

FORM AD-311 (REV. 11/79)

ANGELES NATIONAL FOREST .

A Brief Description of Water Quality Monitoring
By Joe Gonzales, Phys. Science Technician
November 26, 1980

Angeles N.F. planning tasks relating to aerial herbicide spraying, baseline sampling, and Qw monitoring include: (1) design protection requirements; (2) determine adequacy of application procedures; (3) provide for early detection; (4) consider special measures for potentially sensitive areas; (5) determine sample collection points; and (6) determine the number of samples required by specific conditions of the project area.

All the above are addressed for each pesticide spray project where water monitoring is anticipated.

The Forest Hydrologist and Technician pre-project (field) work includes: (1) becoming familiar with the project and areas to be sprayed; preparing a monitoring plan; ordering equipment and supplies; arranging for needed personnel; and arranging for lab analysis of water samples. (2) locating and marking sampling points and measuring time of travel 1/ of water from within the spray unit down to the sampling point; (3) preparing a detailed map of each unit showing: (a) portion to be sprayed, (b) locations of live streams, (c) locations of standing water, (d) location of site where tracer dye will be introduced just prior to spraying (if that method is used).

Project Monitoring

(Watershed Technician assists as an observer of the spray operations.)

The Watershed Technician is responsible for being present at the right location, sampling at predetermined period and intervals, and delivery of samples to an acceptable lab. 2/

Early Warning

Observations - the spotter(s) will note any unusual application of spray. Items to watch for are equipment malfunction, variation in rate of spray delivery, and if unusual application occurs over streams, the information will be relayed immediately to the water sampler and to the COR who will notify Forest Pesticide Use Coordinator.

Procedure

(1) Sample containers are kept clean and have preservatives added.

(2) When sample(s) is obtained, number, military time, and any observations are recorded.

Equipment & Supplies

3+ sample containers
1 conductivity meter
1 radio
1 35mm camera w/film
1 vehicle (pick-up with canopy or van)

Personnel (Watershed) - one sample collector and/or spotter

Costs

50 sample analyses @ $50	$ 2,500
1 UV lamp	80
1 automatic sampler (new 1980)	2,200
misc. supplies & equipment	400
1 Watershed Technician (FY 78, 79, 80)	
20 man days (pre-project)	1,000
50 man days (on project)	2,500
Mileage	250

References

Angeles N.F. Water Quality Monitoring Plan, August, 1980

Forest Contingency Plans

Summary of Water Quality Monitoring Results

During FY 78, 79, and 80, three laboratories were involved in the analysis of approximately 50 water samples: a commercial lab in Pasadena; 3/ a commercial lab in Los Angeles; and a lab of the L.A. County Agricultural Commissioner's Office. Water samples taken the day before, during, and after the spraying were analyzed at the three labs. There was some duplicate analysis (with no cost to the Forest Service) by the L.A. County lab on F.S. projects for quality control purposes. All samples were free of detectable pesticides.

1/ Travel time is measured either accurately by using a flow meter or by estimating using visible amounts of EPA approved dye tracers.

2/ Lab analysis of samples for herbicide is not useful for early warning.

3/ The sensitivity level of the Pasadena lab's instrument for 2,4-D is .002 parts per million.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SBNF

REPLY TO: 2150 Pesticide Use Management and Coordination

May 13, 1981

SUBJECT: Assessment of Aerial Application Technology

TO: Regional Forester

Attached are thoughts and comments on Aerial Application Technology by two District pesticide use coordinators.

Charles H. Tyrrel

ROBERT R. TYRREL
Forest Supervisor

Attachment

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SG

REPLY TO: 2150 Pesticide Use Management May 6, 1981

SUBJECT: Assessment of Application Technology

TO: Jim Bridges, Forest Silviculturist

As you know, our District has not been involved in aerial application for 4 years now. Here are some of my thoughts regarding past spray projects:

Contract performance and contractor compliance was never an issue in any of the projects I was involved with. As project officer, I have always had good communication with the spray pilot and his home office. Perhaps we were fortunate in dealing with exceptional individuals, but their concern over drift, sensitive areas, etc., was impressive. However, I am sure there are other operators that do not share these same concerns, and in that case a strong C.O.R. is needed to insure contract compliance. It must be emphasized that a C.O.R. can only enforce what is in the contract, and it is therefore essential that contracts are all-inclusive and in-depth. It is also essential that the proper authority to insure contract compliance is readily available. Compliance after the damage is done is totally unacceptable.

The biggest problem that I encountered was the ability, or knowledge to insure spray equipment performance, including calibration. This was mainly due to a lack of training, however lack of time and appropriate test areas were also contributing factors.

We also experienced problems with spray drift. These problems were determined to be insignificant due to the nature of the areas we were spraying. I felt that our attention to detail in regards to weather, application methods, formulation and additives was more than adequate. However, with the narrow application window available to us we frequently found ourselves pushing the upper limits to get the job done. This is probably characteristic of this area because of spring weather patterns. When humidity, wind and temperature are well within the prescription there is a good chance it will be too foggy to fly.

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is needed to [illegible] not [illegible]
that a L.O.R. can only [illegible] [illegible]
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It is also essential that the proper [illegible]
[illegible] is readily [illegible]
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The biggest problem that I encountered was the [illegible] knowledge to insure [illegible] equipment performance, including calibration. This was mainly due to [illegible] lack of [illegible] and appropriate test areas [illegible] factors.

[illegible] also experienced problems with spray drift. [illegible] found to be inconsistent due to the nature of the [illegible]. I felt that our attention to detail [illegible] tion methods, organization and additives was more [illegible] with the [illegible] [illegible] frequently found ourselves pushing the [illegible]. This is probably characteristic of [illegible] weather patterns. [illegible] humidity, wind [illegible] within the [illegible] there [illegible]

I feel that any attempt to minimize Forest Service participation is a grave mistake. Extensive Forest Service involvement is essential in an issue as sensitive as herbicide application. We cannot afford to trust someone else's profit oriented conscience when our reputation is at stake. This is especially true since we have suffered so many accusations from anti-herbicide groups in the past.

LEW ERICKSON
Fuels Management Specialist

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Cajon R. D.

REPLY TO: 2150 Pesticide Use, Management and Coordination May 4, 1981

SUBJECT: Assessment of Application Technology

TO: Forest Supervisor

Attached is the information requested by Jim Bridges as per 2150 memo from the RO dated April 22, 1981. Please contact Dennis Cooper if there are questions or you require additional data.

for Dennis R. Cooper
ERNEST T. DIERKING
District Ranger

1. Aircraft being up to FAA & FS snuff is sometimes a matter of trust in the contractor and the knowledge and agressiveness of the assigned helitack person. I think we would have a better handle on this if Zone air people were plugged into pre-work inspections of aircraft.

   Pre-spray contractual arrangements are sometimes difficult to get from contractors. I feel we need to stick by our guns and not let contractor even move any equipment until all our valid questions, concerns and specifications are answered. However, I do feel that we are contributing to the problem with our contracts that include everything under the sun. In order to be a better tool, they need to be shortened and/or standarized.

2. Because we are often retreating areas, utilizing contractor's familiar with the specific job(s) or at least the type of drift hazards associated with that piece of ground, would pay off as opposed to refamiliarizing every new pilot that we get because he works for the "low bidder". Here rests a trade-off decision.

3. In the past we have had the following problems during "project planning and evaluation":

   a) Not making contractor completely handle all chemicals, i.e. from ordering, transportation, pick-up, storage, mixing and container disposal. (Pick-up, storage and disposal have been particular problems!) Even with our basically "full service" contracts, we still seem to end up doing items which contractor was responsible for.

   b) Proper scheduling of our own resources to do an adequate job. Since we don't want to make sacrifices in monitoring, there are usually trade-offs in the application end of the job. It would be helpful if more of our managers and line employees realized the need to do quality work in this area and be accordingly flexible with resources.

   c) COR has this responsibility to provide contracting with feedback about job quality. Once this "feedback" is obtained, it needs to be maintained and looked at the next time a particular contractor bids. Why award a bid to a contractor whose documented record of service is poor or is even questionable?

4. Unless there is some way to inspect contractor's spray equipment ahead of time, we're stuck with it when it arrives; again blind faith. If equipmei is right when it comes to forest - especially with correct nozzles - we ca "fine tune" calibrate in the field. Only good solution is to know our contractors and stick with those who have done professional and quality jobs for us in the past. Again, COR has to pass this information back up the line, so it can be documented to help with the next contract.

5. Some items regarding drift:

   a) Weather monitoring has usually been by belt weather kit. I think that more accurate equipment is available for this critical part of the job. We also need to utilize the portable units we now have; e.g. one at heliport to monitor conditions in relation to those coming in from application locations. I would like us to start utilizing the backlog or stored historical weather data (e.g. "FIRDAT") especially wind patterns. This could be a real planning tool. ✓

   b) Application methods must be geared to minimize drift. If this means reducing output with slower helicopter speeds, reducing altitudes (within safety limits) or shutting down at slower wind speeds, then we should look into these changes.

   c) We definitely need to attract contractors with positive drift-control systems (e.g. "Microfoil"). If this requires additional contract costs, the trade-offs (e.g. law suits, off-site damages, public relations problems and/or possible loss of entire program) are worth extra dollars.

   d) Formulations and additives haven't changed, but maybe it's time to look at these to see if what we're specifying in our contracts provides maximum drift control.

6. One additional problem I've experienced is a competent, state licensed lab to analyze water samples collected during monitoring. Labs are (1) hard to find, (2) usually long distances away (e.g. in other counties, (3) unreasonably slow in running samples (usually taking 2 - 3 months) and (4) very expensive and then results are very questionable. Local labs (Health Department, Agriculture Comm., etc.) can't do samples because of lack of resources. Needless to say, this is beyond the scope of resolution at this level, but it is a real problem and must be looked into if we are to do a quality job.

The "full service type contract" is, in my opinion, the best way to go under normal circumstances. As long as we know the level of integrity of the contractor and his people, it saves us time and energy if we can just plan, direct and evaluate. However, disadvantages outweigh advantages if the contract becomes so unwieldy that it no longer is a working tool.

Dennis R. Cooper

Dennis R. Cooper
District Fuel Management Officer

Some items regarding drift.

a) Weather monitoring has usually been by [illegible] weather [illegible]. I think that more accurate [illegible] at available for this critical part of the job. We also [illegible] the portable units we now have, e.g. one or [illegible] to monitor conditions in relation to those coming in [illegible] application locations. I would like us to start [illegible] the backlog of accrued historical weather data (e.g. [illegible]) especially wind patterns. This could be a real [illegible] tool.

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CLEVELAND NATIONAL FOREST
880 Front Street, Room 6-S-5
San Diego, CA 92188

REPLY TO: 2150 Pesticide Use, Managemant and Coordination

May 20, 1981

SUBJECT: Assessment of Aerial Application Technology

TO: Regional Forester

Comments included below were provided by Tom Ralls, Palomar District Fire Management Officer. A copy of a contract used in the past for aerial spraying in the Palomar District is enclosed and referenced below.

1. We have had little, if any, problems with specifications, performance or compliance. The occasions in the past when we have solicited bids we have only contacted the people who specialize in aerial application by rotary wing (Pages 1, 4, 5 and 7).

2. Communications has not been any problem since we utilize V.H.F. radios or pack sets temporarily installed for the job. This allows for direct contact between the Project Officer and the pilot. The critical spray areas as well as the whole project is flown by the Project Officer describing sensitive areas to the pilot. This is done prior to any aerial application.

3. Project planning is done by the Fuels specialist with the concurrance of the District staff. The Fuels specialist does the evaluation a few weeks after project completion.

Periodic evaluation continues for a period of several months and may extend as long as a year.

4. Procedures to insure spray equipment performance including calibration and spray atomization are included in the contract (Pages 10, 11 and 12).

5. Methods to minimize spray drift are included in Application Conditions (Section 257) and Rate of Application and Coverage (Section 258).

The Palomar District has not used a full Service Contract in the past and does not desire to do so in the future. With such a contract, the Forest Service would have little or no control but still have a big share of the responsibility. Maintaining tighter control with a partial Service Contract is preferred.

RALPH C. CISCO
Forest Supervisor

Enclosure

SPECIFICATIONS

DIVISION 100 - GENERAL SPECIFICATIONS

110 - Scope of Contract

This contract provides for aerial application of herbicides to control brush sprouts in the Palomar Ranger District on the Cleveland National Forest.

111 - Aircraft

Aircraft shall be required to perform over rough mountainous terrain, typical of National Forest areas. Helicopters shall be required to take-off and land on irregular helispots (see map). The aircraft must be of a design and power to adequately perform over such areas. Careful compliance with specifications with respect to power and design of an aircraft is mandatory.

All contractors shall be certified under Part 133 (External Load Operations), and Part 137 Agricultural Aircraft Operations.

120 - Description and Location

121 - Delivery and Release

Initial delivery and release shall be to the Oak Grove Station, approximately 34 air miles East of the Oceanside Municipal Airport. Intermediate helispots will be specified by the Forest Service (see map).

122 - Delivery

The Aguanga Division Fuelbreak can be reached by two roads. The South end of the project is reached by taking the Palomar Divide Road Northwest 9 miles from the junction of the Palomar Divide Road and Highway 79. This junction is approximately 5 miles Northwest of Warner Hot Springs. The North end of the project is approximately 4 miles West from the junction of State Highway 79 and Oak Grove Road on Oak Grove Road. (see vicinity map)

Show-me-trip will be held Wednesday, April 26, 1978, at 10:00 a.m. at the Oak Grove Station, Oak Grove, California. Call Bill Harper at (714) 745-2421 if planning to attend.

123 - Elevations

Spraying shall be over mountainous terrain at elevations ranging from a maximum of 5,500 feet to a minimum of 2,500 feet.

130 - Government - Furnished Property

The Government will deliver to the Contractor the following listed materials, supplies, property or services (hereinafter referred to as "Government-Furnished property") at the places and times specified below. The Contractor shall be liable for all loss or damage of such delivered Government-furnished property until completion and final acceptance of work required under this contract. If the Government fails to make timely delivery of such Government-furnished property suitable for its intended use, and upon written request from the contractor, the Contracting Officer will make an equitable adjustment of contract delivery or performance dates or contract price, or both, pursuant to the "Changes" clause of the General Provisions of this contract.

The Forest Service will provide the following:

131 - Herbicide

Bid Item No. 1

The Forest Service will furnish all herbicide Weedone 170 for this project. Weedone 170 will be located at the Oak Grove Station warehouse and may be picked up by the Contractor there.

132 - Maps

Two-inch or larger scale topographic maps showing the project area and individual spray block areas and acreage, will be provided for each pilot, after award of contract.

133 - Radios

Radios for ground control will be furnished by the Forest Service, as needed.

134 - Locations Markers

If the Forest Service determines that flagmen are needed, the Forest Service will furnish them. The Forest Service will also provide ground markers to delineate areas, or a qualitied person to fly with pilot on reconnaissance flights to locate and delineate boundaries of spray areas.

135 - Traffic Control

Traffic control on highways or roads within or adjacent to the project areas will be provided by the Forest Service when determined necessary.

40 - Contractor Furnished Property

141 - The Contractor shall furnish all adjuvant Lo-Drift manufactured by Amchem Products, Inc., or equal thickening agent compatible with Weedone 170.

142 - The Contractor shall furnish light diesel oil, water and all other additives except the herbicide. The following is a list of possible water sources:

a. Oak Grove Station - 14 miles NW of Warner Hot Springs, CA on State Highway 79 - unlimited supply for project needs.

b. U.S. Navy S.E.R.E. Camp - 10 miles E. Oak Grove Station on State Highway 79 - unlimited supply for project needs.

c. Ware Tank - NW ¼ of Sec. 10, T10S, R2E (see map) - water at the tank may be used. Up to 10,000 gallons for project needs.

d. Sourdough Spring - unlimited supply for project needs.

Water sources other than shown above or on the map must be approved by the Government prior to use.

The Forest Service cannot guarantee availability of water at any of these locations. Any costs incurred in securing and/or transporting the water are the responsibility of the Contractor.

Any water used from these sources must be replaced by the Contractor during the contract or within two weeks after the contract is completed.

143 - Aircraft and necessary services for the contract.

144 - Housing, subsistence, and transportation to and from the bases of operation for Contractor's employees shall be provided by the Contractor. However, space for a camper-type trailer can be made available at the Oak Grove Station, upon request.

150 - Contract Administration

151 - Pre-Work Meeting

Prior to commencement of work, a meeting to discuss work schedules of the contract and the responsibilities of both the Forest Service and the Contractor may be requested by the Contracting Officer to be attended by the Contractor, pilot to be used, the Contracting Officer's Representative and other Forest Service personnel. The meeting will be held at a time and place mutually agreeable to the Contractor and the Forest Service.

152 - Contracting Officer's Representative (C.O.R.)

The C.O.R. will provide on-the-ground administration of the contract, and will currently determine whether or not the Contractor has adequate equipment, facilities, and qualified personnel to satisfy the requirements of the contract. The Contractor shall comply with the decisions of the C.O.R. to make any adjustment necessary to meet the terms of this contract. Before work starts the Contracting Officer will advise the Contractor of the name and address of the C.O.R.

Contractor Furnishing Two

141 - The Contractor shall
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V - Contract Administration

151 - Pre-Work Meeting

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Contractor and the Forest Service.

Duty Station; Duties of Representative C.O.'s

Provide on-the-ground administration of the
to currently determine whether or not the
equipment, facilities, and qualified
with the decisions of the C.O.R. to
meet the terms of this contract.

160 - Performance Schedule

161 - The work shall progress as rapidly as flying weather permits, seven (7) days a week, until the completion of the project. During progress of work, the Contractor shall not remove the equipment and personnel assigned for accomplishing this job to work other areas for either public or private owners, without prior written consent of the Contracting Officer.

170 - Housing and Subsistence

Housing, subsistence, and transportation to and from the bases of operation for Contractor's employees shall be provided by the Contractor.

DIVISION 200 - TECHNICAL SPECIFICATIONS

210 - Equipment Specifications

211 - Helicopters

(a) Helicopters shall be fully equipped and operational including qualified pilots.

(b) Each helicopter shall be capable of carrying a minimum of 65 gallons of spray mixture and to operate from a base of operation at the altitude specified under Division 100, Clause 123, of the specifications with a safe and reasonable fuel load commensurate with flight time required to distribute the spray load.

(c) Each helicopter shall be currently licensed in Standard Category, meet all FAA regulations, and be Forest Service approved. Installation must be attested by FAA Form 337 and all weights shown.

(d) Nonsupersharged helicopters shall not be permitted to work above 6,000 feet Density Altitude.

(e) Nonsupercharged helicopters must have a minimum of 300 B.H.P.

Helicopters of less than 300 B.H.P. shall be equipped with a supercharger.

(f) Helicopters shall be equipped with a 2-1/2 pound minimum dry chemical fire extinguisher.

(g) Helicopters shall be equipped with seat belts and double strap inertia reel harness for the pilot and double strap shoulder harness for each passenger.

(h) Helicopters shall have:

1. Passenger space - 1 plus pilot.

2. Instruments - normal VFR helicopter instruments.

3. Vertical skid extensions are desirable.

4. All time change items shall not be extended beyond the manufacturer's recommended time for overhauls or replacement.

5. All running time on engine and airframe components shall be recorded in aircraft and engine logbooks and be available for inspection at the time the aircraft is inspected.

6. First aid kit meeting requirements of FAR - 121.309 Appendix A, except, the following shall be omitted:

   a. arm splint

   b. leg splint.

7. Emergency Locator Transmitter of a type approved by F.A.A.

8. The helicopter shall be equipped with mirrors capable of viewing the boom and related equipment.

(i) All helicopters provided under this contract shall be subject to U.S. Forest Service downloading procedures (10% of useful load). Allowable pay load in pounds shall be determined from Form 5700-17, Helicopter Load Calculations, using the sample form and instructions provided. If additional downloading of helicopters is necessary for any reason, the pilot in command shall insure this downloading is accomplished. No allowable payload greater than that computed from Form 5700-17 shall be carried.

Each helicopter shall minimally be capable of carrying 400 pounds of spray mixture while hovering in ground effect at 5500 feet elevation and 80 degrees F. using Forest Service load calculation Form 5700-17 which incorporates a 10% reduction in useful load.

(j) Helicopters provided under this contract shall have sufficient flying time available before scheduled maintenance overhaul, or replacement of component parts is to occur to prevent any delay of contract completion.

(b) Helicopters shall have:

1. Passenger ejaculation - plus pilot.

2. Inst ument s - normal VFR helicopter instruments

3. Vertical stid systems are desirable

4. All free passage areas shall not be extended beyond the manufacturer's recommended time for overhaul or replacement.

5. All running time on engine and airframe components shall be recorded in aircraft and engine logbooks and be available for inspection at the time the aircraft is inspected.

6. Liter aid it meeting requirements of FAR - 127 103 Appendix A, except, the following shall be omitte

a. rpm emiter

b. leg splint.

7. Emergency Locator Transmitter s£.3 type approved by F.A.A.

8. The helicopter shall be equipped with mirrors capable of viewing the boom and related equipment.

(1) All helicopters provided under this contract shall be subject to U.S. Forest Service downloading procedures (125% of useful load). Allowable pay load in pounds shall be determined from Form 5700-17, Heli copter Load Calculations, using the sample form and instructions provided. If additional downloading of helicopters is necessary for any reason, the pilot in command shall insure this downloading is accomplished. No allowable payload greater than that computed from Form 5700-17 shall be carried.

Each helicopter shall minimally be capable of carrying 900 pounds of cargo while hovering in ground effect at 90 feet elevation and 80 degrees F. using Forest Service calculation form 5700-17 which incorporates a 10% reserve in useful load.

[illegible] under this contract shall have available [illegible] before [illegible] if required maintenance overhaul or component [illegible] is to occur to prevent any [illegible] complete.

(k) Substitution of Helicopters. During the course of this contract, the Contractor may substitute or replace helicopters with approved aircraft meeting contract specifications, but only after receipt of written approval from the Contracting Officer.

212 - Fueling

Helicopter engines and propellers or rotors shall be stopped before and during servicing of helicopter.

213 - Spray Equipment

Each spray distribution system shall be certified for the type helicopter used on the project. The distribution system shall be leak proof and be capable of applying the mixture at the rate of application set forth in the specification. Prior to commencement of work, or before any change in type of herbicide, the spray system shall be flushed with water or commercial cleaning solutions. The operating apparatus shall include the following:

(a) Pumping system designed to provide a constant pressure capable of distributing the spray mixture in an even and unbroken swath at the specified application rates.

(b) Emergency nonleaking dump valves of adequate capacity, adequately vented to jettison the load, and so installed to prevent blow-back into fuselage. The ratio of tank capacity (in gallons) to the cross section area of the dump valves in square inches shall not be greater than 10 to 1. There shall be no restriction or reduction in area between the tank and the dump valve. The dump valve control shall be readily accessible to the pilot and the control linage protected to prevent accidental opening of the valve.

(c) Spray tanks with a 65-gallon minimum capacity and designed for rapid filling.

(d) Pump shall be capable of producing a minimum of 30 PSI to all boom nozzles.

(e) Spray boom inside diameter shall not be less than one inch.

(f) Nozzles shall be the hollow cone type without whirl plate. Nozzle type D-4, D-6, or D-8 will be used as necessary to produce desired spray pattern.

(g) Nozzles shall be mounted on the spray boom so that the nozzle direction is backward, parallel to, or not more than ten degrees downward from the horizontal axis of the aircraft in flight.

(h) Sprayboom length shall be a minimum of 32 feet, tip to tip, with a minimum of 20 spray nozzle locations. Maximum shall be 38 feet.

214 - Facilitating Equipment

The Contractor shall provide and maintain the following equipment at the designated base of operation:

(a) Spray mixing equipment and storage tanks of sufficient capacity to permit at least four hours of continuous spray application.

(b) Herbicide will be stored at the Oak Grove Station warehouse. Contractor may use this warehouse for storage or he may remove the herbicide to a storage facility of his own selection. If Contractor elects to use the Oak Grove Station for storage he must notify the Contracting Officer's Representative at least 72 hours prior to a need for access.

(c) When in the Contractor's possession herbicide and/or herbicide mix is his responsibility and must be safeguarded. This may be accomplished by having someone with the herbicide or by removing herbicide from the project site for safekeeping.

(d) A loading system capable of filling a 65-gallon tank in a maximum time of 60 seconds. The loading system shall be capable of recirculating the contents of the storage tank. Filter screens shall be installed between the storage tank and the meter and between the meter and fill nozzles. Helicopter spray tanks shall be calibrated and plainly marked to provide a positive means of measuring the spray solution load in gallons.

(e) Meters of adequate capacity to accurately measure the spray mixture loaded into each helicopter. Each meter shall have been certified accurate by a licensed inspector of the Bureau of Weights and Measures.

(f) Gasoline supply and refueling service for all helicopters sufficient to permit at least four hours of continuous spray application. "No Smoking" signs with 3 inch letters are required on all sides of gasoline supply.

(g) Parts, equipment and facilities necessary to service and maintain helicopter and spray equipment for continuous operation during the period of the contract.

(h) Fire extinguishers fully charged and inspected (carbon dioxide ten-pound minimum) at the gasoline loading station and at the spray mixture loading station.

23A. Mosquito Control

The Contractor shall provide and maintain the following equipment at the designated base of operation:

(a) Spray mixing equipment and storage tanks of sufficient capacity to permit at least four hours of continuous spray application.

(b) Herbicide will be stored at the Oak Grove Station warehouse. Contractor may use this warehouse for storage or he may remove the herbicide . storage facility of his own selection. If Contractor elects to use the Oak Grove Station for storage he must notify the Contracting Officer's Representative at least 72 hours prior to need for access.

(c) When in the Contractor's possession herbicide and/or herbicide mix is his responsibility and must be safeguarded. This may be accomplished by having someone with the herbicide or by removing herbicide from the project site for safekeeping.

(d) A loading system capable of filling a 65-gallon tank in a maximum time of 60 seconds. The loading system shall be capable of recirculating the contents of the storage tank. Filter screens shall be installed between the storage tank and the meter and between the meter and fill nozzles. Helicopter spray tanks shall be calibrated and plainly marked to provide a positive means of measuring the spray solution load in gallons.

(e) Meters of adequate capacity to accurately measure the spray mixture loaded into each helicopter. Each meter shall have been certified accurate by a licensed inspector of the Bureau of Weights and Measures.

(f) Gasoline supply and refueling service for all helicopters sufficient to permit at least four hours of continuous spray application. "No Smoking" signs with 3 inch letters are required on all sides of gasoline supply.

... and facilities necessary to service and maintain helicopter and spray equipment for continuous operation during the period of the contract.

220 - Personnel Qualifications

221 - Pilots

A. General

1. Each pilot shall display upon demand:

   a. A commercial Pilot Certificate or ATR with appropriate rating (Rotorcraft-Helicopter).

   b. Written evidence of qualification to transport external loads.

   c. Written evidence of passing a FAA currency flight check under FAR, Part 135.

   d. An Agency Pilot Qualification Record Card issued by a designated inspector of pilots.

   e. Each pilot shall comply with all requirements of the State of California, and counties in which operations are to be conducted, relative to the application of herbicide. This includes, but is not limited to, possession of a current California Aircraft Pilot's Pest Control Certificate.

   f. At age 40, proof of EKG showing an absence of myocardial infarction, with Class II medical shall be mandatory.

2. Each pilot shall, at the discretion of the Contracting Officer, pass an Agency flight check in make and model over typical terrain. The Agency flight check shall be in addition to the experience requirements listed below.

3. Pilots shall not function as mechanics.

4. All pilots without previous agency approval in the make and model to be flown shall have evidence of successful completion of the manufacturer's approved ground school in the make and model, if available.

5. Pilots shall have two seasons of low-level, or aerial applications of herbicide experience.

B. Experience

1. All Activities - Pilot's shall have accumulated as Pilot-in-Command the minimum flight times listed below. Flight time shall be determined from a certified pilot log. Further verification of flight hours may be required at the discretion of the Contracting Officer.

		Minimum Flight Hours
a.	Helicopter	1,500
b.	Weight Class *1	100
c.	Turbine or Reciprocal *2 (whichever is applicable to contract helicopter)	100
d.	Make, model, or subsequent series	50
e.	Make and model in preceding 60 days	10
f.	Make and model in preceding 30 days	5
g.	Typical terrain *3	200

Footnotes:

*1 Weight Class: Light (1-5), Medium (6-15 place), Heavy (16-26 place).

*2 100 hours Pilot-in-Command in turbine helicopters unless Schedule of Items permits and contractor supplies reciprocating-engine helicopter.

*3 Typical terrain experience requirement is: Pilot experience in mountainous terrain with varying elevations of 4,000' to 12,000' pressure altitude at temperature ranges of 75 to 90 degrees F., rugged peaks, deep canyons, cliffs, rock outcrops, steep slopes, mountaintop helispots, mountainside landing spots surrounded by trees, brush, and rocks; persistent wind, and weather which includes snow, rain, lightning, and dust storms, strong winds in the mountains and canyons with sudden up and down drafts and direction changes. Verification of previous experience in typical terrain may require special effort of pilots to produce maps, written climatic and wind data on areas where they have previously operated.

C. Flight and Duty Limitations. All helicopter flight crews flying on Forest Service missions, will be limited to the following flight hour and duty limitations:

1. Flight time shall not exceed a total of seven hours per day.

2. Pilots accumulating 30 or more hours of flying in any six consecutive days shall be off duty the following full calendar day.

3. Pilots must have a minimum of 10 consecutive hours off within 24 hours after the beginning of any duty.

3. Temperatures

4. Duty includes flight time, ground duty of any kind, and standby or alert status at any location.

5. During any 14 consecutive days, pilots shall be off duty for two full calendar days. Days off duty need not be consecutive.

6. Flight crews flying a combination of aircraft for transportation of personnel and other types of Forest Service missions will be limited to the requirements in paragraphs 1, 2, and 3 above.

7. Any duty of 2 hours or more in one day shall be considered a day of duty.

8. For purposes of flight duty limitations, a day is defined as 24 hours beginning at 0001 hours and ending at 2400 hours.

222 - Other Personnel

Contractor shall provide other personnel necessary for loading, maintaining, and supporting each helicopter furnished.

230 - Formulation

Spray Formulation

Contractor shall prepare spray mix as follows:

Weedone 170	1 Gal.
Lo-Drift Spray Additive*	Per instructions on label
Diesel oil	1 Gal.
Water	7 Gal.
	10 Gallons

* Low-Drift manufactured by Amchem Products, Inc., or equal.

240 - Mixing of Herbicides

All mixing shall be done under the supervision of the COR. Mixing procedures will be in accordance with label instruction and may be modified by the COR as needed.

Mixing shall be done in areas, mutually agreed upon by the Contractor and COR or inspector, where accidentally spilled herbicide will not enter streams, ponds, lakes or Helipads.

At the beginning of each shift, or more often as he deems necessary, the Contractor will inspect spray mixing, loading and distribution systems for tight, secure and sound fittings, connections, and hoses.

To prevent contamination of water, suction hoses used for herbicide will not be used to draw water from streams or tanks. An air gap separation must be provided between the fill hose and the mixing tank.

5. During any 14 consecutive days, pilots shall be off duty for two full calendar days. Days off duty need not be consecutive.

6. Flight crews flying a combination of aircraft for passenger operation of personnel and other types of Forest Service missions will be limited to the requirements in paragraphs 1, 2, and 3 above.

7. Any duty of 2 hours or more in one day shall be considered a day of duty.

8. For purposes of flight duty limitations, a day is defined as 24 hours beginning at 0001 hours and ending at 2400 hours.

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each [illegible], or [illegible] be [illegible] necessary, [illegible] and [illegible] mixing [illegible] and distribution [illegible] and filter [illegible] nozzles, and hoses.

[illegible] suction hose used for [illegible] An air gap separation [illegible] and the mixing [illegible]

Contractor shall furnish diesel oil and transportation to helispots for diesel oil and water at his expense. The water trucks should be capable of drafting and filtering own water from streams and ponds. The Contractor shall furnish one complete water transportation and mixing system.

Tank trucks or helicopters containing herbicide solution shall not be moved from the active operating area without prior permission from the Contracting Officers Representative or the Inspector.

Contractor shall supply buckets or pans to catch drips of herbicide mixture from leaking equipment. Leaks shall be promptly repaired.

Loading nozzle shall be kept in a drum when not in use to prevent spillage.

Water trucks shall not contain residue that may effect the performance of the herbicide or additive.

241 - Clean Spray Equipment

Prior to commencement of work each system shall be flushed by the Contractor with water or commercial cleaning solution.

250 - Application of Herbicide

251 - Calibration

Calibration shall be set for 10 gallons per acre and maintained within 5% of this rate.

Helicopter and distribution system shall be tested and calibrated for accuracy jointly by the Forest Service and the Contractor prior to the commencement of operations. Calibration shall be for even distribution, speed of travel and effective swath. The right is further reserved to make tests at any time during actual operations if the Contracting Officer's Representative deems it advisable. All such tests shall be at the expense of the Contractor.

252 - Method of Application

The herbicide shall be applied from an average height of 35 feet above the ground cover when safe flying practices permit. Otherwise, the altitude shall be mutually agreed upon by the Contracting Officer's Representative and the Contractor or his pilot. Spraying shall be done at an airspeed of between 40 and 50 m.p.h.

253 - Selection of Areas

The Contracting Officer's Representative will select the sequence of areas to be sprayed. They will be selected to permit continuous progression from one area to another. Specific areas may be excluded from application.

254 - Code Compliance

All aerial application of herbicide will be in accordance with the California Food and Agricultural Code.

255 - Buffer Zone

When deemed necessary by the Contracting Officer's Representative, a "buffer zone" will be left untreated along any live stream, lake, waterway, road or other area within or adjacent to any spray area. No spray solution shall be applied closer than 200 feet either side of live streams designated on the ground.

256 - Flight Pattern

Flight pattern of the helicopter between the base of operation and the project area shall not be oriented over any lake, reservoir, or other water storage area.

At no time will flight be conducted over any residence or any private land unless specifically authorized by the Contracting Officer's Representative.

Flight patterns in the project area shall be designated to minimize flight above and parallel to drainages and maximize 90° crossings of drainages when loaded with herbicide.

257 - Application Conditions

The Contracting Officer's Representative during his day-to-day administration of the contract on the ground, will decide, using the following conditions as a guideline, when spraying operations shall begin or cease. Spraying operations will usually be prohibited when any one of the following conditions exists on the spray area:

a. Wind velocity exceeds 5 miles per hour.

b. Temperature exceeds 80 degrees F.

c. Snow or ice covers brush.

d. Raining or when the U.S. Weather Bureau predicts a 70 percent or greater chance of rain in the next 24 hours in the area of application.

e. Foggy weather.

f. Relative humidity is less than 25 percent.

g. The air turbulence (thermal updrafts, etc.) is so great as to seriously affect the normal spray pattern.

h. Inversion layer present.

i. Other emergency conditions.

5.

258 - Rate of Application and Coverage

The rate of application is 10 gallons of spray mixture applied uniformly to one acre of area. The entire project area, excluding designated nonspray areas, shall be covered with spray. Application shall be made without swath overlap. Application shall be made by using the single swath technique applying the total volume on each parallel flight.

The spray system shall be closed at the end of each spray run and during the time when a turn is being made to start another spray run. A turn constitutes a change in forward direction of more than 10 degrees.

260 - Air Operations

261 - Flight Conditions

It is understood the pilot is captain of his ship and is free to refuse any flight or landing which he considers hazardous or unsafe. Operations under this contract shall normally entail risks, which the Contractor hereby assumes, including such risks as the following:

a. High-altitude operations in rugged, mountainous terrain, in characteristically unstable air conditions, with maximum pay loads.

b. Take-offs and landings at natural or slightly improved emergency operating locations which are restricted by natural or vegetative obstructions.

c. Prolonged slow-flight patrols for reconnaissance and similar missions.

262 - Reconnaissance Flight

The Contracting Officer's Representative may require the following reconnaissance flight hours to acquaint the pilot with specific conditions of the project areas. Multiple flights may be made during the Reconnaissance Period. Such flight(s) shall be at the Contractor's expense.

Bid Item No. 1

1.0 hour (at Contractor's expense)

Additional reconnaissance flights for each project may be ordered and will be paid in accordance with Division 410 of these specifications.

All flights shall be with Forest Service personnel aboard and shall be performed with spray tanks empty and not less than 300 feet above ground vegetative cover.

259 - Care of Spraying and Dusting Equipment

The rate of application is 10 gallons of spray mixture applied uniformly to one acre of area. The entire project area including designated nonspray areas, shall be covered with spray. Application shall be made without overlap. Applicator shall be made by using the single swath technique applying total volume on each parcel flight.

The spray system shall be closed at the end of each spray run and during the time when a turn is being made to start another spray run. A turn constitutes a change in forward direction of more than 10 degrees.

260 - Air Operations

261 - Flight Conditions

It is understood the pilot in charge may refuse any flight or landing which he considers dangerous or unsafe. Operations under this contract shall normally entail risks within the contractor hereby assumes, including but not limited to the following:

a. High-altitude operations in rugged, mountainous terrain, in characteristically unstable air conditions, with attendant gusty loads.

b. Take-offs and landings at natural or slightly improved emergency operating locations which are restricted by natural or vegetative obstructions.

c. Prolonged slow-flight patrols for reconnaissance and observation.

Contracting Officer's Representative may require the following flight hours to accomplish the pilot with [illegible] flight conditions of the project areas. Night flights may be [illegible] the Reconnaissance Period. Such flight [illegible]

[illegible] Inspector's expense.

[illegible]

[illegible]

[illegible] emergency flights for each project may be ordered [illegible] in accordance with Division 6.10 of these Specifi-

[illegible] be with [illegible] Forest Service personnel aboard and [illegible] spray tanks empty and not less than [illegible] ve cover.

263 - Operation

During the actual work period, application operations may commence at dawn and continue until operations are suspended each day by the Contracting Officer's Representative. Daily operations may be resumed in the evening if all operating conditions are favorable. The usual effective application period is from two to six hours per day depending on location of project and climatic conditions. Sunrise and sunset will be determined from tables published by the U.S. Naval Observatory and U.S. Weather Bureau.

264 - Radio Communications

Pilots shall monitor the radio frequency assigned by the Contracting Officer's Representative at all times while airborne.

265 - Fire Resistant Clothing

Pilots shall wear longsleeved shirt and trousers (or longsleeved flight suit) made of fire resistant polyamide or aramide material, leather boots and leather, polyamide or aramide gloves. The shirt, trousers, boots and gloves shall overlap by two or more inches when the pilot is in a sitting position with hands on the collective and cyclic. Pilots shall not wear clothing made of synthetic materials, except the fire resistant clothing described above.

266 - Aviator's Helmet

Pilots shall wear an aviator's protective helmet with chin strap whenever the helicopter is in flight. The helmet shall include a boom microphone and headset and shall be fitted to the individual covering the head, ears and back of the neck.

267 - Passengers

Under no circumstances shall the Contractor be permitted to carry a Forest Service employee in his aircraft during spray operations.

268 - Maps

The maps provided the pilot are intended to show only the general size and location of the work locations and are not necessarily precise as to shape, dimensions, and hazards. The position of cultural and topographical features, when shown, may be approximate.

Within the general work area, the Contracting Officer's Representative may exclude specific areas for application. Nonspray areas will be marked or otherwise designated by the Forest Service prior to spraying on that segment of the general work area. Nonspray areas will be excluded from payment.

DIVISION 300 - INSPECTION AND ACCEPTANCE

310 - Compliance Inspection

311 - Equipment

Each helicopter, application system, all facilitating equipment and material will be inspected by the Forest Service prior to commencement of spray operation for compliance with the operational requirements and air worthiness. Additional inspections may be made throughout the contract. The Contractor shall either put in acceptable condition or replace with an acceptable substitute any helicopter or other equipment and material not acceptable to the Forest Service at the time of inspection.

312 - Inspection of Equipment During Use

The Government reserves the right to inspect and determine condition of all equipment during the period of use. On equipment found incapable of operating efficiently due to breakdown, mechanical failure or other causes, the Contractor shall make necessary repairs within 48 hours of notification that said repairs are required. Failure to make repairs may be considered grounds for default or termination under Article 5 of the General and Labor Standards Provisions, Part A for non personnal Services. If the Contractor cannot make the necessary repairs within 48 hours he shall, with the Contracting Officer's approval, provide substitute equipment meeting contract specifications.

313 - Spraying

Inspection of areas being treated will be made by the Forest Service during the spraying operation by oil sensitive cards or other means.

Random sampling on fuelbreaks by oil sensitive cards will be taken to determine spray density and droplet size.

(a) Droplets shall be 70 or more per square inch.

(b) Droplet size shall be 200 to 400 microns. Where check shows unacceptable application, the Contractor may be required to respray the unsatisfactorily treated area at no additional cost to the Forest Service.

SUBSECTION 3.0 - INSPECTION AND ACCEPTANCE

3.1 Inspection

3.11 - Equipment

Each unit, prior to shipment, will be identified with
and material will conform to the Project Design
to ensure it is adequate for maximum cold (90°F)
temperature and/or particles. Additional inspections
before shipment to ensure the Contractor shall
in accordance with an acceptable system
any deficiency or wear and tear occurring
the Forest Service may be time of inspection.

3.12 - Inspection of Equipment During Use

The Government reserves the right to inspect and maintain
of all equipment during the period of use. On equipment found
inoperable or operating efficiently due to breach of warranty
failure or other cause, the Contractor shall make necessary
repairs within 48 hours of notification that said repairs are
required. Failure to make repairs may be considered grounds for
default or termination under Article 5 of the General and Labor
Standards Provisions, Part A for non personal Services. If the
Contractor cannot make the necessary repairs within 48 hours he
shall, with the Contracting Officer's approval, provide substitute
equipment meeting contract specifications.

3.13 - Spraying

Inspection of areas being created will be made by the Forest
Service during the spraying operation by oil sensitive cards
or other means.

Random sampling on Tualdenas by oil sensitive cards will be
taken to determine spray density and droplet size.

(a) Droplets shall be 70 or more per square inch.

(b) Droplet size shall be 200 to 400 microns. Where sudden shower
unacceptable application loss, the Contractor may be required to
treat erratically treated area at no additional
cost.

314 - Helicopter Pilots

The Contracting Officer will be the sole judge of proficiency and acceptability of a pilot to perform under this contract. Pilots may be reexamined at any time. Check rides may be made in an area of designated base heliports to evaluate pilot's ability, attitudes, landings and take-offs from local helispots.

Pilots who become involved in accidents or who fail to pass check rides conducted by or for the Forest Service will automatically be grounded and their approval suspended. Reinstatement as an approved pilot will be at the discretion of the Contracting Officer.

The Forest Service may ground temporarily or for the duration of the contract any pilot who flies recklessly, continues to do ineffective work, or otherwise conducts himself in a manner detrimental to the purpose for which contracted.

320 - Disposal of Waste Material

321 - The contract will not be accepted as complete until the Contractor disposes of all excess spray mixture, and other liquid waste. Disposal must keep the material from washing into streams, lakes, or standing water and endangering surrounding vegetation.

322 - The Contractor shall maintain the areas used as the base of operations in a clean and orderly fashion during the spraying operation and shall leave the areas clean after completion of operation. Contractor shall dispose of all oil, grease and other containers he has furnished.

323 - Rinsing Procedures

The following procedure will prevail unless superceded by different instruction of the County Agriculture Commissioner.

Immediately after emptying a container, rinse three (3) times with the same diluent as used for mixing; pour the rinse into the spray tank load for distribution. (Also wash the outside of the container). Volume of rinse should be 10% of the volume of the container for each rinse. Other approved rinse methods, at least equal in effectiveness to the triple rinse and drain procedure, may be used. For example, one approved alternative rinse method uses a continuous or jet-rinse procedure.

The Forest Service will dispose of all herbicide and other containers they have furnished in accordance with County regulations.

DIVISION 400 - MEASUREMENT AND PAYMENT

410 - Measurement

411 - Reconnaissance Flights

The initial reconnaissance period shall not be measured for payment. Additional reconnaissance flights ordered shall be recorded in a flight log by the pilot and initialed by the Forest Service Representative. No payment will be made for these flights unless a properly designated Forest Service employee is aboard.

The reconnaissance flight time will be measured in hours and tenths and will be the elapsed time in the air from take-off to landing. Additional reconnaissance flights ordered will be paid at the rate of:

$125.00 per hour

412 - Acreage

Acres within the boundaries as established on the ground will be determined from maps using a dot grid or planimeter or computed from compass and ground measurements. Acreage paid will be the net of designated areas excluding nonspray areas and unsatisfactorily treated areas.

420 - Basis of Payment

Payment will be made to the nearest acre plus any paid reconnaissance flight time less any applicable deductions.

All flights and total acres will be recorded on Form 6500-122, Daily Flight Report Invoice, and must be approved by the Contracting Officer's Representative and Contractor's Representative at the conclusion of each day. It will not be necessary for the Contractor to submit other invoices or statements.

No additional payment will be made for move in and move out expenses of helicopters and support equipment to and from Contractor's home base or from one project location to another.

United States Department of Agriculture

Forest Service

LTBMU

Reply to: 2150 Pesticide Use, Management and Coordination

Date: May 18, 1981

Subject: Assessment of Aerial Application Technology

To: Regional Forester

Because the LTBMU has no experience with aerial application of pesticides we cannot provide you a meaningful response to your 2150 request of April 22, 1981.

W. A. MORGAN
Forest Supervisor

United States Department of Agriculture | Forest Service | Mendocino NF

Reply To: 2150 Pesticide-Use Management and Coordination (2470) Date: May 20, 1981

Subject: Methods Application Group, Aerial Application (Your ltr. 4/22)

To: Regional Forester

We have had no experience with the Methods Application Group at Davis as far as their work in aerial applications are concerned. After talking to Brian Sturgess, we decided to deal with to the broader responsibilities of the M.A.G. and particularly in the field of herbicides.

The number of people in California who have broad practical knowledge in the use of herbicides in more than a very local area can probably be counted on one hand. Research data is also lacking in California; most research was done in the early 1960's and was confined to use of 2,4-D and 2,4,5-T in some rather narrow ecological niches. References for use on the Mendocino come mainly from Oregon and may or may not be applicable. (I am talking about applied data and research, not basic research.)

In draw a parallel, many of us thought we were very knowledgeable in young growth management, the work of the Silvicultural Development Unit at Burney has been invaluable in advancing the level of knowledge in this field. The same approach might be used by M.A.G.; the need certainly exists in the field of pest control. We do need Regional personnel whose only job is verification, monitoring, evaluation, documenting, and training in pest control, especially vegetation management (with and without herbicides). For example:

1. Is there any herbicide effective for fall release of whiteleaf manzanita? ("T" and "D" are not).

2. Are there any legumes could be planted that would retard brush and provide nitrogen?

3. How much damage will be sustained with the use of "D" over Ponderosa Pine, White fir, etc.?

4. What kinds of ground spray equipment area available and what are the limitations?

5. How competitive is dogwood and how do you control it?

As to the specific points raised in your April 22 letter, we can see that work needs to be done in all of those areas:

1. We have always had problems with getting the contractor on site while the conditions for spraying were right. Perhaps some of the procedures being used with the helitorch would apply to aerial spraying. Also, having the helicopter under the control of the Forest Service would eliminate the problems with the contractor's helicopter being impounded at the whim of local governments.

2. Radio communications for ground to air control of the helicopter are badly needed.

3. Work needs to be done on a variety of herbicides to provide a "kit of tools" to be applied to the spectrum of conditions found in the field.

4. Continued research and development is needed on mechanical equipment for site preparation and release under California conditions. Most of the mechanical equipment now in use was developed for conditions in the south and is not very well suited to wart of our situations.

5. Continued research into applications of fire for release and stand maintenance.

We understand the M.A.G. is doing some of this type of work, but we are unaware of anyone documenting what is going on the Forests except for the request by the R.O. for some reports.

Paul F. Schuller

PAUL F. SCHULLER
Timber Management Officer

United States Department of Agriculture | Forest Service | Plumas National Forest | 159 Lawrence Street
P.O. Box 1500
Quincy, CA 95971

REPLY TO: 2150 Pesticide-Use, Management and Coordination

May 20, 1981

SUBJECT: Assessment of Aerial Application Technology

FS RECEIVED R5
MAY 2 5 1981
FOREST PEST MANAGEMENT STAFF

TO: Regional Forester, R-5

There has been no aerial applications of herbicides on the Plumas since 1976. The Forest is not current in aerial application techniques. If we do aerial application, a refresher course would be appropriate. We see the need to design a comprehensive refresher course on aerial applicaton of herbicides as a priority job for the Methods Application Group at Davis.

Herbicides drift when applied aerially. The public is concerned about drift. The second priority for the group should be development of methods to minimize spray drift.

Project planning and evaluation and training in calibration need to be emphasized.

We are not sure what is meant by full service type contract. Our last contract was for the contractor to purchase the herbicide, mix, load and aerially apply the material. The Forest Service involvement was for inspection purposes only, including the use of spray cards for application and drift measurements. Water monitoring was also done. Does the full service contract mean less participation than the above?

Lloyd Britton

LLOYD R. BRITTON
Forest Supervisor

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

S-T NF

FS RECEIVED

MAY 27 1981

FOREST & ST MANAGEMENT STAFF

REPLY TO: 2150 Pesticide Use, Management and Coordination

Date: May 20, 1981

SUBJECT: Assessment of Aerial Application Technology (RF's 2150 Memo of 4/22/81)

TO: Regional Forester

We have the following comments and suggestions concerning the present technology of aerial application of pesticides. Our responses follow the outline of your memo.

1. Spray aircraft specifications, contract performance, and contractor compliance.

   Some contracts do not include specifications for all label requirements, e.g., requirements for humidity level spray limitations. These requirements are to be complied with by applicator, but Forest Service should have contract control.

   Recommend that contract aircraft specifications include the use of a microfoil boom.

2. Improvement of communications between project officer and spray pilot, including briefing on drift control, avoidance of sensitive areas, etc.

   Communications should be coordinated between project officer, field observers, and water quality monitors, as well as the aircraft pilot. Pilot should be continually aware of the on-the-ground effects of his performance.

   For very important or sensitive spray project areas aerial oblique photos could be provided before the project is started. These photos would be very useful during the project briefing.

   For some projects on nearly level terrain the spray area boundary could be clearly marked by running a tractor line around the unit. This would be much more visible than a flag line.

3. Project planning and evaluation.

   We are presently experiencing a manpower shortage which was not anticipated during the planning of projects and development of some contracts. Manpower availability should be a consideration in future project planning.

4. Procedure to insure spray equipment performance including calibration and characterize spray atomization.

   We recommend the use of the "raindrop nozzle" for the purpose of spray drift control. This nozzle is effective for this purpose and it does not seem practical to spend time and money attempting to make improvements.

5. Methods to minimize spray drift:

   a. Meteorology - have humidity controls in all contracts where it is part of label requirements.

   b. Application methods - recommend raindrop nozzle and microfoil boom.

   c. Special equipment - Use of "helitorch" type of equipment on spray areas where helicopter needs altitude and spray drift is most critical.

   d. Formulations and additives - no comments.

Full service contracts may be the only option available to use in the near future considering manpower shortages. It may be politically advantageous to have contractors perform water quality monitoring, although the costs would be very high.

We would appreciate being informed of your response to the Director of Forest Pest Management in the Washington Office.

BARNEY COSTER
Forest Supervisor

United States Department of Agriculture | Forest Service | Sierra NF

Reply to: 2150 Pesticide Use, Management and Coordination Date: May 22, 1981

Subject: Assessment of Aerial Application Technology

To: Regional Forester

The Sierra National Forest has not utilized aerial application of herbicides for the past 3 to 4 years. Our assessment of aerial application is aimed at the planning through application phase.

1. Some Districts feel that planning is complicated and time consuming. They plan for 1 to 2 months for a spray project, the applicator comes in, and if weather is favorable, sprays one day, gets paid and is out.

2. The cost of aerial application is becoming prohibitive. Contracts are for about $60/acres. Districts feel they can tractor spray for less expense (+ $30/acre). A large acreage 500 + acres are needed to make it a cost-efficient project.

3. District personnel do like full-service contracts which minimizes Forest Service participation in the field. Locally, however, it is difficult for the contractor to get rid of empty herbicide containers after the project because the disposal site is closed. It is only open twice per year and for two weeks each period. If the contract is completed outside of these two periods, the Forest Service normally ends up with the empty containers to store until the disposal site opens.

4. We feel that in order to minimize drift, and to avoid possible lawsuits, good weather record keeping is a must for each project. As a minimum, wind speed and direction, temperature and relative humidity should be documented for each load or every other load.

If conditions permit, the helicopter should be as close to the ground as safety permits, usually 35-50' above the vegetation.

Spray thickening agents should be added to all formulations of herbicide whether applied by air, tractor boom spray or hand spray. It is a most cost efficient method to reduce drift which could cause unwanted damage outside of the project area.

As long as the controversy exists in the use of phenoxy herbicides for type conversion maintenance sprays, plantation site preparation, and plantation release, the Forest Service will be monitored by outside interest groups who are opposed to herbicide uses of any kind. We need to present to the public,

2150 Pesticide Use, Management and Coordination May 22, 1991

Assessment of Aerial Application Technology

...ional Forester

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a united effort to eliminate or reduce any fears they have regarding our continued use of aerial application of herbicides. We know we can do the job safety, but we also need to inform a concerned public.

If you have any questions, please contact John Lorenzana, at FTS 467-5653.

John K Stithem

JOHN K. STITHEM
Resource Officer

United States Department of Agriculture | Forest Service | Klamath NF

JUL 7 1981

Reply to: 2150 Pesticide-Use Management and Coordination

Date: May 20, 1981

Subject: Assessment of Aerial Application Technology
Your Ref: 2150 - April 22, 1981

To: Regional Forester, Pacific Southwest Region

RECEIVED
JUL 1 1981
FOREST PEST MANAGEMENT STAFF

1. Basically we feel aircraft specifications are adequate. However, if a listing of the capability of various machines were available (what does best where) it would be helpful. Contract performance is generally good, however we have a real problem with delays by the contractor prior to commencement of spraying. Based upon the pre-work conference we man-up to accomplish our obligations but all too often the contractor does not meet his schedule in being ready on site. Each day of delay costs approximately $2,500 in standby crew time. If some delay penalty could be initiated to encourage their compliance with their schedule, it would reduce costs significantly.

2. Our system of a closed communication frequency between pilot and C.O.R. is quite successful. Pre-spray briefing is not a problem once the contractor is on site.

3. Project planning is not a problem on Districts with a history of aerial application projects. Those Districts with little experience seem to over-kill planning and E. A. preparation. A plot sample system of evaluation is generally used. However interpretation of survey results is experience related.

4. Calibration does not seem to be a problem. Selection of spray equipment is based upon literature and existing regulation.

5. A. Spot weather forecasts are almost mandatory for any of our projects and are fairly accurate.

B. C. & D. Any research that would allow spraying at higher wind velocities than present with the same safety margin would be a great help.

Experience elsewhere with full service contracts has been good, and I encourage their use. The less involvement by the Forest Service in aircraft specifications, load calculation etc. The cheaper the bid, less hassle with the contractor, and less delay time. We should only be concerned with the application of the Chemical, and leave aircraft regulation to the F.A.A. The only problem with full service contracting, is no Forest Service personnel can fly in the ship unless it has been inspected. This should be no problem if buffers, boundaries, helispots, etc. were adequately marked.

James F. Rathbun

JAMES F. RATHBUN
Acting Forest Supervisor

United States Department of Agriculture | Forest Service | R-6

Reply to: 2150 Pesticide Use, Management and Coordination | Date: August 12, 1981

Subject: Assessment of Aerial Application Technology

To: John Barry
WO, FPM Methods Application Group
2810 Chiles Road
Davis, CA 95616

Enclosed are three responses to your letter of April 15, which requested input on problems associated with aerial applications.

The lack of response from the field is somewhat surprising; however, we believe this is indicative that they are not experiencing significant problems in most facets of herbicide applications.

There is one area in which we do need assistance. As we move more into the "job basis" contract, we need to tune up our skills and knowledge in monitoring or checking for contractor compliance. A state-of-the-art review with recommendations on publications to consult and appropriate methods to check contract compliance would be appreciated.

PAUL E. BUFFAM, Director
Forest Pest Management

Enclosures

cc: TM
Range
AS
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RO

2150 Pesticide Use Management and Coordination May 18, 1981

Assessment of Aerial Application Technology

Forest Supervisors; Directors, TM, Range, Wildlife, and L&M

REPLY DUE JUNE 30

Enclosed is a letter from the Methods Application Group (MAG) seeking comments on problems associated with aerial application of pesticides.

The problems we identify and solve over the next few years may be extremely crucial in maintaining a viable aerial program. Identification of the real problems deserves our best shot.

Don't be limited to just those areas of concern listed in the letter. Likewise, the opinion expressed on the "full service" contract is just that! Use of the job basis contract is Forest Service policy (FSM 5752.1), but most important, it is being used successfully and its use may be at least a partial solution to our problems of money and manpower.

PAUL E. BUFFAM

PAUL E. BUFFAM
Acting Deputy Regional Forester of
State and Private Forestry

Enclosure

cc: AS
A&F Management

RFPerkins:pj

RF	S
Deputy RF	Fire
PP&B	F&WL
IO	L&M
AM	Range
KAS	Rec
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Fiscal	WS
Law Enf	AP&D
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PM	Fire Programs

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5/18/81

United States Department of Agriculture

Forest Service

Reply to: 2150 Pesticide Use, Management and Coordination

Date: June 25, 1981

Subject: Assessment of Aerial Application Technology (WO ltr. 4/15)

To: Regional Forester

Our main interest concerning aerial application of pesticides centers around (1) the initial project evaluation phase, (2) operational monitoring, and (3) posttreatment evaluation and monitoring.

The environmental assessment process and IPM have considerably strengthened project proposals and treatment selection. The concern lies in the inconsistency between Forests as to the depth or degree of evaluation. Our planned fall meeting should address this in more detail.

Many aerial application monitoring techniques are currently in use, and others are being reviewed. A state of the art review would be appropriate at this time and a minimal acceptable procedure identified.

Posttreatment monitoring, both long and short term is essential to any pesticide program. We have fallen short in the past in our attempts to justify our proposals and treatments with inadequate effectiveness data. A means of identifying time periods, evaluation criteria, and data collection procedures would be helpful. This program phase should also exhibit some uniformity throughout the Region.

The full service contract is a valuable tool in this Region's pesticide program. The key to its effectiveness and reliability lies in the contract language and qualification of those performing compliance checks.

If you require additional information, contact Don Connett, at extension 2958.

Asa D. Twombly

ASA D. TWOMBLY
Leader, Plans and Silviculture Group
Timber Management

United States Department of Agriculture | Forest Service | RO

Reply to: 2150 Pesticide Use Management and Coordination

Date: June 24, 1981

Subject: Assessment of Aerial Application Technology

To: Director, Forest Insect and Disease Management

We have not heard of any problems with delivery systems for herbicides that need to be investigated or researched. What we have heard are problems associated with program continuity based on financing difficulties from Fiscal year to Fiscal year and the need for better integration of our pesticide program into our management programs. There is a need to present this program in a "better light" so that it is understood and concurred with at all levels. As it is now, if Forest and/or Districts can find a reason - whether plausible or not - not to complete a program, it is generally dropped.

The discussion of "full service" contracts is interesting. As pointed out in your cover letter it is a very viable alternative. The reasons stated in the Washington office letter for avoiding these contracts indicates a lack of understanding in how to administer contracts. With a set of good stipulations written into it and a capable, contientious inspector to enforce it, a contract is an excellent tool.

One area, which is adjunct to the contract situation, which needs to be explored and some direction provided to the ground is in the area of Memorandums of Understanding with State and county pest/weed control agencies. Many of these organizations have excellent programs which we can join with to provide the integrated management program on Federal, State and private lands that is necessary for successful control or eradication of a target species. Many Forests are searching for the appropriate format on which to build a relationship with a State agency, county weed board, or private control group. Good direction in this area will be more beneficial to the pesticide program than worrying about delivery techniques. The industry will take care of the latter, but won't help with our coordination problems.

for R W Hamner

ROBERT M. RICHMOND
Director of Range Management

United States Department of Agriculture | Forest Service | RO

Reply to: 2150 Pesticide Use Management and Coordination Date: July 1, 1981

Subject: Assessment of Aerial Application Technology

To: Deputy Regional Forester of State and Private Forestry

Please refer to your memorandum of May 18, 1981 regarding your request for identification of problems relating to aerial application of pesticides.

We in Administrative Services are also interested in the input you may receive from the field as it relates to the contracting process for obtaining satisfactory aerial application services and technology.

We would be more than happy to work with you to provide input for areas of concern identified which may involve the contractual process.

Robt. L. Wonkel

From: ROBERT CROWE
Director of Administrative Services

MAY 26 1981

Reply to: 2150 Pesticide Use Management

Date: May 20, 1981

Subject: Assessment of Aerial Application Technology

To: John Barry, National Pesticide Application Specialist

We are not sure what the latest technology in aerial application of pesticides is. What we are refering to is the number of professional group meetings (weed societys, agricultural engineers, etc.) where papers are presented and articles in journals and other publications which relate to new ideas or techniques that never make it to the hands of the field person. My question is: What is the latest technology?

We in Region 9 are using the standard methods of aerial application of pesticides. We are refering to herbicides as that is basically what we work with. We are utilizing the standards that were developed by the PNW and others in the past and we are also using the Raindrop Nozzle but need research information to varify that what we are doing is correct and necessary.

We do not have any problems with aircraft specifications as we specify the constraints for herbicide application, i.e.; air speed, flying height, pump pressure, etc. To be acceptable the aircraft has to be able to meet these criteria.

Contract performance and contractor compliance are functions of contract administration and in this area we are weak as the program is small and training has been very limited. Basically, the only formal training received is through the State Restricted Use Pesticde Training Programs. In some states within our Region the aerial application category is separate from the forest use category, so training becomes more complicated.

The only problems we have experienced in communications is mechanical. Usually the helicopters arrive without the necessary adaptors for our radios. Communications is a function of contract administration and having a positive relationship with the contractor. Our contractors are concerned about drift and all the other criteria of doing a good job as spraying is their source of income.

We calibrate our helicopters using the system that Siskiyou NF in Region 6 utilizes. This calibration is a modification of the textbook method as we specify nozzle size and adjust the number of nozzles to achieve calibration. By specifing the nozzle in the contract we have better control over droplet size and number.

We do have a concern about droplet size and numbers. Droplet size is based on static tests. What is actual size and distribution of droplets in actual operations; and actual effect of using the raindrop nozzle? PNW publications state the hollow cone D8-46 nozzle is the best combination for herbicide

application based on coverage. What is the droplet distribution and numbers? We need this type of information so that we can specify the proper nozzle for our conditions and so that we have data to support our actions to the public. Presently we tell the public that we use the raindrop nozzle and/or low drift additive to control drift. We question to what extent do the rain drop nozzles actually control drift under field conditions and are they really needed?

The full service contract is a good approach to accomplishing our task. The only minimizing of Forest Service involvement is that we are not required to inspect the helicopter. We do not use the aircraft for recon or fly in it for any reason thus it can be a restricted use aircraft and only needs to meet FAA standards. If the contractor supplies the pesticide the requirements are spelled out in the contract. Your concerns are not addressed in any contract as they have to do with contract administration. To insure that the wrong area is not sprayed, we provide good maps and aerial photos plus identify the areas on the ground. We also have an observer in each spray areas so that he can help guide the pilot to the area.

This leads me to one of my problems with aerial application. Bits and pieces of information are scattered throughout research and a few forests or regions. It seems that each user is doing the job in his own way and has no other knowledge of how the job can be done. The only training available is through state certification programs for restricted use pesticides. In this area the training pertains more to row crops and does not necessarily fit the forest environment. The fact is that we are not using restricted use herbicides in our aerial programs and therefore this training is not required.

There may be standards and guidelines printed but we are not aware of them. Region 6 developed an applicators manual that was to be adapted for nationwide useage. What has happened to this publication? We need this type of information but it does not seem to be available.

I visualize this handbook as a package that not only covers the aerial application but contains information to help select the proper nozzle or combinations, boom length considerations and other information that is necessary to properly plan and accomplish a good, safe, and sound aerial application program.

Refering to my first paragrph, a technology transfer system is needed in pest management. We feel that we are using the latest technology but we are not sure of this fact as we do not have access to the latest information. The information needed is located in many different places and is exceedingly difficult to obtain.

Thank you for the chance to express my views and concerns. If I can be of further assistance do not hesitate to contact me.

Larry L Gross

LARRY L. GROSS
Regional Pesticide Coordinator

cc: Gross

United States Department of Agriculture | Forest Service | SA

Reply to: 2150 Pesticide Use Management and Coordination Date: June 16, 1981

Subject: Assessment of Aerial Application Technology

To: John W. Barry
National Pesticide Application Specialist
FPM/MAG

Jack, I asked Julie and Larry for comments on your April 15 letter. Here are Julie's. I think she has some excellent points.

1. Limited number of interested aerial applicators. Solution: An attempt should be made to promote aerial application, particularly to the cooperatives. This may result in a larger, more lucrative market for the applicators.

2. Seed orchard spraying recommendations are inconsistent. Solution: Technology transfer efforts should be consistent reflecting the current "state of the art."

3. Current seed orchard recommendations may not result in the highest benefit/cost ratio. Solution: Special projects to define criteria for the most effective swath widths, application speed and application technique should be continued in order to improve the benefit/cost ratio of applying pesticides aerially.

4. Sensitivity of public to aerial application on Forest Service lands. Solution: The Forest Service has a responsibility to evaluate the effectiveness and the performance of the application. This may not include direct involvement in the calibration but should definitely include good communications between the pilot and spray project officer. All sensitive areas should be monitored in order to document any possible problems. Residue analysis of first spray would be beneficial.

5. Full service contracts. Solution: If the specifications of the contract are complete and concise, then theoretically a check of the aircraft before the application and an assessment of the performance should reveal any problems. Communications between Forest Service personnel and applicators must be open and complete. At no time should we contract to have a seed orchard treated without specifying technique, sensitive areas, etc.

In addition to Julie's comments, I think we also need to develop a standardized approach to aerial application on federal lands. Attached is a draft of our first effort in this area. We plan to provide our orchard managers who want to make aerial applications with an easily understood, step by step format to follow.

If there is any other way I can assist you, please let me know.

JOHN W. TAYLOR, JR., Ph. D.
Chemical Coordinator
Forest Pest Management

United States Department of Agriculture

Forest Service

NA

Reply to: 2150 - Pesticide Use Management and Coordination

Date: June 12, 1981

Subject: Assessment of Aerial Application Technology

To: Methods Application - Davis, CA
ATTN: John W. Barry

This responds in part to your April 15, 1981 request for comments on the above subject. Larry Gross, in Milwaukee, has answered you directly.

Regarding your assessment of how well the Forest Service is utilizing the latest technology in aerial application of pesticides, you may have problems in finding a meaning for the words, "how well." We try to use the type of aircraft best suited for the job. The aircraft are equipped with the latest communication and application equipment. We apply the most efficacious and environmentally acceptable pesticides. Applications are made according to label directions and in compliance with the NEPA process, State and Federal laws, and Forest Service policy. We deserve a high score.

We think the following issues are responsible, to a large degree, for problems we experience in our aerial pesticide application programs: (1) opposition to pesticides, (2) poor technique, (3) poor contract preparation and its administration, and (4) need for training.

Opposition to chemicals will continue. The General Accounting Office says we need to increase our credibility by strengthening the decision making process by providing more thorough evaluations of alternative control methods. We think we can also increase our credibility by recognizing the truth and admitting that we are using all available technology that is practical. We should not imply that we are the victims of knowledge gaps, nor make a monster out of "drift" in order to justify research. This feeds upon the fears of those who are opposed to chemicals, it unfairly clouds the issue, and it reduces our credibility when we say our applications are safe. It takes our eye off the target and distracts us from a real problem like communications.

Communications between aircraft, spray contractors, project directors, and field technicians is essential if sensitive areas are to be avoided and if spray drift is to be minimized. We use sophisticated communication systems in all large projects, yet we need to improve upon our techniques to quickly alert pilots of changes in meterological conditions and other developments that interfere with accurately placing pesticides in the target area.

Good training and good contract preparation and administration are a part of this technique. They would solve many of the problems we presently blame on lack of technology. Field technicians, Contracting Officers, and Contracting Officers' Representatives should be well versed in pesticide use management.

They should know Forest Service policy regarding pesticides. They should be familar with Federal and State pesticide laws. They should know how to calibrate aircraft and check calibration and otherwise identify breakdowns or potential breakdowns in the system.

Regarding the items for which you express special interest, you now have our thoughts about the need for training and need to develop good techniques that improve contract performance and compliance. We think this is also inseperable from equipment performance and project evaluation.

Full service contracts do present some problems. However, if the problem areas are identified during the planning phases and incorporated into the contract, and if the contract is administered properly, we believe it would reduce cost, increase efficiency, and allow full utilization of present technology. Ultimiately this would increase our credibility and relieve pressure we receive from those opposed to chemical pesticides.

If we can be more responsive, or if we can better address the items of which you expressed special interest, please let us know.

Charles L. Hatch

for PETER W. ORR
Staff Director
Forest Pest Management